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Monetary and Non-monetary SWO Retention Bonuses: An Experimental Approach to the Combinatorial Retention Auction Mechanism (CRAM)

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December 2009

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MONETARY AND NON-MONETARY SWO RETENTION BONUSES: AN EXPERIMENTAL APPROACH TO THE COMBINATORIAL RETENTION AUCTION MECHANISM (CRAM)

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Submitted in partial fulfillment of the requirements for the degree of

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TABLE OF CONTENTS

LIST OF FIGURES

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LIST OF ACRONYMS AND ABBREVIATIONS

BAH	Basic Allowance for Housing
BAS	Basic Allowance for Subsistence
CRAM	Combinatorial Retention Auction Mechanism
MBA	Master of Business Administration
NMI	Non-monetary Incentive
NPS	Naval Postgraduate School
OJT	On the Job Training
ROTC	Reserve Officer Training Corps
SRB	Selective Re-enlistment Bonus
SWO	Surface Warfare Officer
SWOCP	Surface Warfare Officer Continuation Pay
SWO CSRB	Surface Warfare Officer Critical Skills Retention Bonus
SWOS	Surface Warfare Officer School
UIP	Universal Incentive Package
USNA	United States Naval Academy
YCS	Years of Commissioned Service

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I. INTRODUCTION

A. PURPOSE

This project evaluates the retention impact and the Navy's cost savings of offering an individually designed combination of non-monetary and monetary incentives to members of the Surface Warfare Officer (SWO) community. The SWO community is suffering its lowest retention rate since the early 1990s. SWOs hesitate to remain in their warfare community through the completion of two consecutive department head at sea tours to fulfill additional sea duty assignments once they complete their initial commissioning obligation commitment.[1]

As a result, the Navy introduced two separate monetary bonuses to increase retention rates within the SWO community. However, the bonuses have done little to raise retention to the levels the Navy desires. The SWO community is actively seeking another form of incentive to increase retention rates.

Previous research conducted by students and professors at the Naval Postgraduate School (NPS) identified incentives SWOs most desired. Additionally, combinatorial auction research may prove useful in developing tools to combine the incentives into packages at a low cost to the Navy. This project will use an experimental approach to examine the decision-making process SWOs might use when choosing between monetary and non-monetary retention bonuses. We expect to observe that experimental subjects will choose incentives that maximize their personal retention value. The experiment is a retention mechanism that optimally combines monetary and non-monetary incentives to achieve desired SWO retention. The goal is to develop combinations of incentives that reduce retention bonus costs while maximizing individual self-interests.

[1] Constance M. Denmond, Derek N. Johnson, Chavius G. Lewis and Christopher R. Zegley, "Combinatorial Auction Theory Applied to the Selection of Surface Warfare Officer Retention Incentives" (MBA Professional Report, Naval Postgraduate School, 2007).

B. RESEARCH OBJECTIVES

This research will achieve the following objectives aimed at increasing the Navy's SWO retention rates:

Primary Objective:

- Develop a retention mechanism that optimally combines monetary and non-monetary incentives to achieve desired SWO retention rates.

Secondary Objective:

- Monitor the individual decisions through an experimental approach to the Combinatorial Retention Auction Mechanism (CRAM).

C. SCOPE AND METHODOLOGY

This project investigates the potential for allowing SWOs to combine individually chosen non-monetary incentives (NMIs) with already existing monetary incentives to create an optimal personalized incentive package sufficient to meet the Navy's SWO retention goal. The project begins by investigating the history of Surface Warfare and describing the issues challenging SWO retention. Next, the project will describe the history and aims of the Navy's current monetary incentives. The authors will use the data from previous NPS projects to run an experiment exploring the functionality of a retention mechanism that optimally combines monetary and non-monetary incentives.

The methodology for this Master of Business Administration (MBA) project will involve both qualitative and quantitative data. Our data collection method will consist of the following:

- Develop an experiment based on CRAM and a reverse auction system.
- Administer the experiment to NPS students in the Monterey area.
- Monitor the individuals' behavior during the decision-making process when choosing between monetary and non-monetary retention bonuses.

The exact details of the experiment will be described in detail in Chapter V.

D. CHAPTER OUTLINE

Chapter I describes the purpose of this MBA project and lists the questions the project intends to address. Chapter II is a literature review detailing the history of the Surface Warfare community and the current SWO bonuses offered by the Navy. The chapter describes in depth the bonuses and why they are ineffective in attaining the retention Navy's goals. Chapter III describes the retention mechanism; explaining monetary retention incentives, non-monetary retention incentives, second-priced sealed bid auctions, and the CRAM used to develop the experiment. Chapter IV gives in depth descriptions of experimental economics and explains price theory experiments, game theory experiments, and individual decision theory experiments. Chapter V describes the experiment design used in this thesis and provides the experimental results, as well as the conclusion to our project and recommendations for further research.

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II. LITERATURE REVIEW

A. LITERATURE REVIEW

It is commonly argued that the best asset of any military force is its people. While the Navy builds the most technologically advanced aircraft carriers and state-of-the-art multi-functional destroyers, all war-fighting tools are useless without highly trained personnel to operate them. Another component that is vital to our military effectiveness is leadership. Without strong, positive, knowledgeable leaders shaping both the professional and personal lives of the men and women they lead, an aircraft carrier would not function properly nor could a guided missile destroyer fulfill its missions.

Retention of qualified and motivated officers in the Surface Warfare community is vital for the United States Navy's future success. Life onboard surface ships creates many challenges, from leaving one's family and friends for, on average, six months while on deployment, to having very little or no privacy while underway. In addition, the Navy has adopted the philosophy of doing more with less and optimizing the manpower available. The manpower plan has put further strain on the already difficult life of a SWO. Having to be a leader and a manager, the common SWO finds himself swamped with several different tasks, and struggling to complete these tasks. Research conducted in 2006 by Sharron Graham at the Naval Postgraduate School explains, in detail, the plethora of reasons why SWOs decide to leave the warfare community. The SWO community has to maintain 275 Department Head positions to sustain current operational commitments.[2] Low retention carries a high cost for the Navy.

The Navy spends several years and hundreds of thousands of dollars to develop its SWOs into apt ship drivers and leaders. A four-year college education is a requirement for most SWOs. Although the Navy Reserve Officer Training Corps

[2] Navy Personnel Command PERS41, *SWO Career Planning Brief*, http://www.npc.Navy.mil/NR/rdonlyres/71C709C7-0D35-4329-9257-CEF93B366A38/0/SWOCareerPlanningBrief0903.pdf (lecture, Naval Postgraduate School, Monterey, CA, March 18, 2009).

(ROTC) is the largest SWO commissioning source, the United States Naval Academy (USNA) ranks second in the number of SWOs annually commissioned.[3] The total cost to educate a Midshipman through four years at the Naval Academy is $351,800.[4] Before SWOs with the rank of Lieutenant can make the commitment to become a Department Head, they must spend two years at the Ensign grade and two years as a Lieutenant Junior Grade. The current pay for an Ensign is $2,763 monthly; for a Lieutenant Junior Grade the pay is $3,483 monthly.[5] For this example, the government's total undiscounted expense for four years of commissioned service is $149,904. Add the price associated with attending USNA and the cost jumps to $501,704. This serves as a lower-bound estimate because it does not consider the allowance the Navy provides for healthcare, rent (basic allowance for housing (BAH)), and food (basic allowance for subsistence (BAS)). Those amounts vary based on duty location. Also, the estimate does not account for the cost of various other required officer schools a SWO attends to maintain nautical proficiency.

1. History of the Surface Warfare Officer

On October 13, 1775, the Continental Congress voted to outfit two sailing vessels, armed with carriage and swivel guns and manned by crews of eighty men, and sent them out on a three month mission to intercept transport ships carrying supplies to the British in America.[6] This initial action of Congress gave birth to what is now the United States Navy. Currently expanded to encompass several different mission areas, on the sea, in

[3] Constance M. Denmond, Derek N. Johnson, Chavius G. Lewis and Christopher R. Zegley, "Combinatorial Auction Theory Applied to the Selection of Surface Warfare Officer Retention Incentives" (MBA professional report, Naval Postgraduate School, 2007).

[4] Get Into Academy, *Updated Value of Education for USNA, USMA, and USAFA*, January 1, 2007, http://www.getintoacademy.com/57/updated-2007-2008-value-of-education-for-usma-usna-and-usafa/ (accessed March 18, 2009).

[5] Defense Finance and Accounting Service, *DFAS - Military Pay Tables*, January 1, 2009, http://www.dfas.mil/militarypay/militarypaytables.html (accessed March 18, 2009).

[6] Naval History and Heritage Command, *The Birth of the United States Navy*, October 4, 2000, http://www.history.Navy.mil/faqs/faq31-1.htm (accessed March 18, 2009).

the air, and under the sea, the birthplace and backbone of the Navy remains the surface fleet. The Surface Warfare community is the oldest community in the United States Navy.[7]

2. Surface Warfare Officer Career Path

Once officers earn a commission in the Navy and begin their career path as a career designated SWO, the new officers report immediately to a surface ship. New officers do not attend any formal school, but are expected to learn their job through on the job training (OJT). Once onboard the ship, officers start learning of all the various tasks required. Officers are given a division to manage and must juggle leading their men while also learning the watchstanding responsibilities of positions such as conning officer, combat information center watch officer, and officer of the deck. Once qualified through the formal boarding process in these three watchstations, officers are sent to a three-week long Surface Warfare Officer School (SWOS) in Newport, Rhode Island, where they learns about all the different communities of the United States Navy, ranging from Marine Battalions to Aircraft Carriers, and the basics of certain weapons systems and war fighting tactics. SWOS qualifies officers for the Surface Warfare community; upon completion, they are designated as SWOs and earn their Surface Warfare pin. The officers earn this pin through an intense interview board with their ship's Commanding Officer and the Department Heads on his ship. An officer is given 18 months to earn the warfare pin and become designated as a qualified SWO.

The progression of a junior SWO is a standard one. A new officer will spend a total of 45 months assigned to a seagoing command for what is considered their first and second Division Officer tours. Upon completing the first and second Division Officer tours, the officer has the choice of separating from active military service at their 48-

[7] Sharron Graham, "An Exploratory Study: Female Surface Warfare Officers' Decisions to Leave Their Community" (master's thesis, Naval Postgraduate School, 2006).

month mark, not taking the SWO retention bonus while signing on for a two to three year shore duty assignment, or taking the SWO bonus and obligating themselves for the next six years as a Navy SWO.[8]

3. History of Surface Warfare Officer Continuation Pay (SWOCP)

The Navy realized that a significant number of officers chose to leave the Surface Warfare community after their initial service obligation, compromising the Navy's ability to fill SWO Department Head billets. To combat the outflow of qualified officers, the Navy created a system of monetary incentives. Currently, the Navy offers two monetary incentives aimed at increasing SWO retention. The first Navy bonus was SWO Continuation Pay (SWOCP). SWOCP was established and implemented in FY 2000.[9] The SWOCP bonus is a $50,000 bonus aimed to entice SWOs to stay in the Surface Warfare community long enough to complete the full Department Head tour requirement, essentially adding three years, divided into two, eighteen month tours of active sea duty to the initial commissioning commitment.[10] The Navy expected the bonus to combat the outflow of officers from the Surface Warfare community. Initially, the monetary incentive did help to retain officers, but retention again began to fall over the years. Officers elected to leave the community even with the initial monetary bonus.

4. History of Surface Warfare Officer Critical Skills Retention Bonus (SWO CSRB)

Still experiencing a decrease in retention, the Navy had to restructure its incentives to retain quality officers and stop them from leaving the Surface Warfare community and either transferring to another warfare community or separating from the military. Thus, the FY 2006 Defense Appropriation Act established a second SWO

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[8]Navy Personnel Command PERS41, *SWO Career Planning Brief*, http://www.npc.Navy.mil/NR/rdonlyres/71C709C7-0D35-4329-9257-CEF93B366A38/0/SWOCareerPlanningBrief0903.pdf (lecture, Naval Postgraduate School, Monterey, CA, March 18, 2009).

[9] Secretary of the Navy, *SECNAVINST 7220.84 Surface Warfare Officer Continuation Pay*, Instruction (Washington, DC: SECNAV, 2000).

[10] Secretary of the Navy, *SECNAVINST 7220.84 Surface Warfare Officer Continuation Pay*, Instruction (Washington, DC: SECNAV, 2000).

bonus, the SWO Critical Skills Retention Bonus (SWO CSRB).[11] The SWO CSRB is a $25,000 bonus that does not add any additional service commitment time to the three-year extension required after accepting SWOCP. Therefore, a SWO who takes both monetary based retention incentive bonuses receives a total of $75,000 and they only owe a total of three years payback in addition to their original commitment incurred at commissioning. Offers commonly refer to the total bonus allotted as the "SWO bonus."[12]

5. Eligibility Requirements

SWOCP is a special pay. United States Code-Title 37 Section 319 (37 USC 319) authorizes SWOCP for eligible officers who obligate to remain on active duty and complete one or more tours of duty during which they may serve as afloat Department Heads.[13] An eligible Surface Warfare Officer who executes a written agreement may be paid an amount not to exceed $50,000 upon the Secretary of the Navy accepting the agreement.[14]

To be eligible for the SWOCP special pay bonus, an officer must be an officer of the Regular Navy or Naval Reserve on active duty who:

- Is qualified and serving as a Surface Warfare Officer (designation 111X).
- Has been selected for assignment as a Department Head on a surface vessel and offered a contract by PERS 41, in conjunction with a Department Head or special screening board.

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[11] Chief of Naval Operations, *Junior Surface Warfare Critical Skills Retention Bonus*, Naval Message (Washington, DC: CNO, 2006).

[12] Constance M. Denmond, Derek N. Johnson, Chavius G. Lewis and Christopher R. Zegley, "Combinatorial Auction Theory Applied to the Selection of Surface Warfare Officer Retention Incentives" (MBA professional report, Naval Postgraduate School, 2007).

[13] Secretary of the Navy, *SECNAVINST 7220.84 Surface Warfare Officer Continuation Pay*, Instruction (Washington, DC: SECNAV, 2000).

[14] U.S. Congressional Record - House, *H4165 Congressional Record House 14 June 1999*, Report (Washington, DC: Congress, 1999).

- Has completed any service commitment incurred through the officer's original commissioning program.
- Is able to complete the afloat Department Head tours or a single longer tour as assigned by PERS 41.
- Is designated to fill Department Head sequencing plan billets.
- Applies prior to graduation from Department Head School (officers will be ineligible for SWOCP if they do not apply prior to graduation).

The FY 2006 Defense Appropriations Act established the SWO CSRB to better compete for the strengths and talents of Surface Warfare professionals.[15] The SWO CSRB simply increases the total amount of the SWO bonus. Conceptually the two bonuses are essentially a single bonus, but the payment processes and accounting authority cause the two bonuses to remain separate from one another.

Eligibility for SWO CSRB is very similar to SWOCP requirements:

- Permanently appointed Lieutenant.
- Completed two Division Officer tours or a single longer tour.
- Not completed more than 25 years of active duty.
- Completed 5 years of military service.
- Sea duty assignable.
- Approved for SWOCP

6. Payment Scheme

The total SWO retention bonus offered by the Navy is $75,000. Like most military bonuses, the SWO bonus is not paid up front. Instead, the bonus is paid out over almost six years.

[15] Chief of Naval Operations, *Junior Surface Warfare Critical Skills Retention Bonus,* Naval Message (Washington, DC: CNO, 2006).

The following is a break down of the payment plans for both SWOCP and CSRB:

- SWOCP: $10,000 paid upon initial signing. Once the officer starts Department Head School (by the 7 ½ year mark of their career as a commissioned officer), they receive the first of four $10,000 payments. The anniversary of their Department Head School start date or first Department Head tour report date marks the payment of the three remaining annual payments.
- CSRB: Officers will receive payments on the anniversary of their year commissioned service (YCS) 6, 7, and 8. The first payment installment is $15,000, followed by payments at YCS 7 and 8 of $5,000 each.

For typical officers who accept the SWO bonuses when they make the rank of Lieutenant at their four-year commissioned mark, the following exemplifies their payment schedule for both bonuses:

YCS 4: $10,000 SWOCP

YCS 5: None

YCS 6: $15,000 CSRB

YCS 7: $15,000 ($10,000 SWOCP+$5,000 CSRB)

YCS 8: $15,000 ($10,000 SWOCP+$5,000 CSRB)

YCS 9: $10,000 SWOCP

YCS 10: $10,000 SWOCP

B. SUMMARY

Though there are periodic rumors on the seafront, albeit from no known source, of an increase in the total SWO bonus, the truth is that it still totals $75,000. The Navy still faces retention issues in meeting Department Head requirements in the Surface Warfare community. Previous research at NPS, conducted by Benjamin Cook and Brooke Zimmerman in 2008, suggests incorporating non-monetary retention incentives through a

reverse auction mechanism. Our project uses combinations of monetary and NMIs that reduce the Navy's retention bonus costs while maximizing the SWOs' self-interest. We will use experiments to examine the behavior patterns of individuals in the decision-making process when choosing their optimal incentive package.

III. RETENTION MECHANISMS

A. INTRODUCTION

"The most straightforward approach to retention bonuses is to only use monetary incentives."[16] However, monetary incentive alone may not always be sufficient to achieve desired retention goals, as is the case in the SWO community. This chapter discusses the potential of combining NMIs and monetary incentives to reduce the Navy's costs of monetary incentives while increasing the total value delivered to the individual SWO.

B. MONETARY RETENTION INCENTIVES

To date, the monetary retention mechanisms discussed in Chapter II are the only incentives the Navy applies toward retention in the SWO community. However, previous NPS research conducted by Constance M. Denmond and others in 2007 suggests that a monetary bonus is insufficient to address the reasons why junior officers are dissatisfied with and choosing to leave the SWO community after completing their initial commissioning commitment.[17] Additionally, their research found that the current financial incentives are not sufficient to entice SWOs to remain in the community; perhaps no amount of financial incentive would suffice.[18]

C. NON-MONETARY RETENTION INCENTIVES

As the SWO survey conducted by Denmond et al., made apparent, money is not always the driving force for retention. Some examples of NMIs SWOs value include

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[16] Peter J. Coughlan, William R. Gates and Brooke M. Zimmerman, "The Combinatorial Retention Auction Mechanism (CRAM): Integrating Monetary and Non-Monetary Re-Enlistment Incentives." (Technical report, Naval Postgraduate School, forthcoming).

[17] Constance M. Denmond, Derek N. Johnson, Chavius G. Lewis and Christopher R. Zegley, "Combinatorial Auction Theory Applied to the Selection of Surface Warfare Officer Retention Incentives" (MBA professional report, Naval Postgraduate School, 2007).

[18] Constance M. Denmond, Derek N. Johnson, Chavius G. Lewis and Christopher R. Zegley, "Combinatorial Auction Theory Applied to the Selection of Surface Warfare Officer Retention Incentives" (MBA professional report, Naval Postgraduate School, 2007).

homeport choice, geographic stability, and sabbatical. The combination of monetary and NMIs can be used to offer SWOs a greater retention incentive value. This has propelled us to investigate the role of NMIs and how they could be used in lieu of and in combination with the monetary incentives already offered to the SWO community to increase retention.

1. Cost versus Value

When exploring NMIs as retention tools, one must be able to differentiate between the terms cost and value. In the experiment conducted for the research associated with the project, cost is the true cost to the Navy of the NMI offered; value depends on the individual's evaluation of the NMI offered.

The goal of the Navy, in terms of NMIs, is for the cost of a NMI to be less than the value to the individual choosing the incentive. "If an individual service member values an incentive more than it costs the Navy to provide, then both the Navy and individual gain from providing the incentive as part of a retention package."[19] If the individual's value is less than what the incentive costs for the Navy, then neither receives satisfaction from the NMI. The value individuals receive depends on how much the incentive is worth to them. Figure 1 graphically depicts the two scenarios of value exceeding cost and of cost exceeding value.

[19] Jason Blake Ellis, "Variability of Valuation of Non-Monetary Incentives: Motivating and Implementing the Combinatorial Retention Auction Mechanism" (master's thesis, Naval Postgraduate School, 2009).

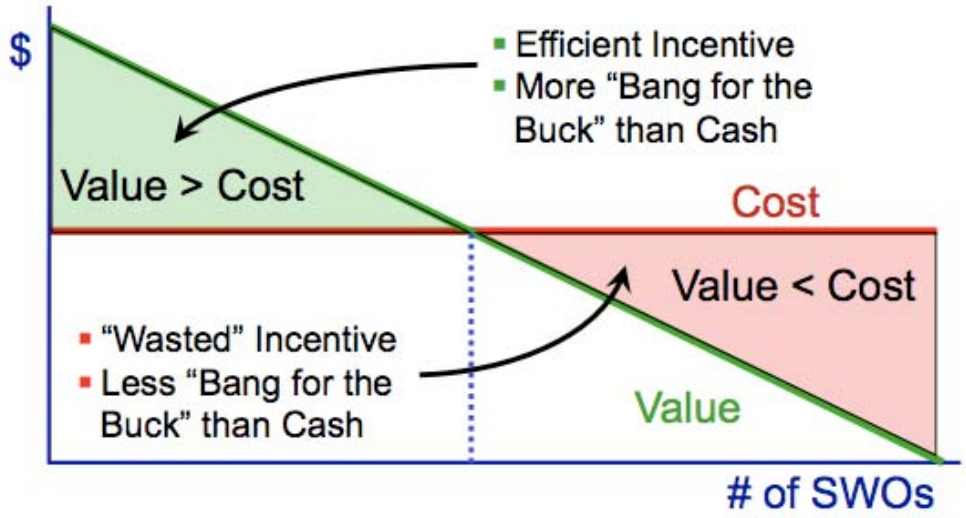

Figure 1. NMIs: Cost vs. Value (From Coughlan and Gates, 2007)

2. Non-monetary Incentive Portfolio

When developing a combined monetary and NMI portfolio, the optimal Navy incentive package would combine incentives that are of high value to the individual, but low cost to the government. If the value of the incentives included in packages offered to SWOs outweighs the government's cost of the incentive package, then it is in the best interest of the Navy to offer SWOs those combination incentive packages. By offering a package in which the individual's value of each incentive exceeds the cost the Navy incurs from providing it, then both parties can be better off; it is in the government's best interest to retain the individuals with the incentive packages that reduce costs to the government and provide higher total value to the individual. Conversely, as Figure 2 illustrates, the Navy would not want to offer incentives in which the cost to the Navy is higher than the perceived value to individual.

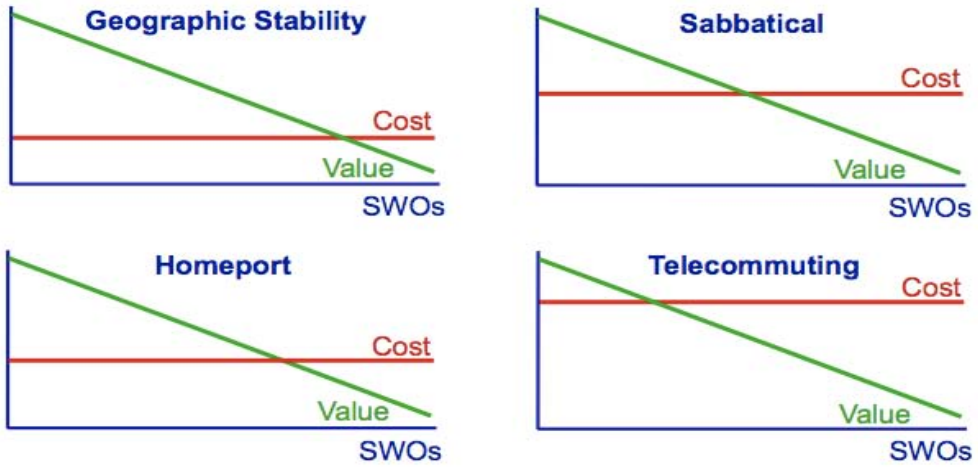

Figure 2. NMI Portfolio (From Coughlan and Gates, 2007)

Figure 2 illustrates the concept of cost versus value in a NMI portfolio. Theoretically, geographic stability and homeport in this illustration offer individual values that exceed the Navy's cost to provide the incentive for most individuals. On the other hand, telecommuting and sabbatical are perceived to have a higher cost to the Navy than value to most individuals. The lower the cost incurred by the Navy and the higher the perceived value of the incentive to the individual, the more benefit that is created by the incentive.

If the Navy were to provide any of these incentives "universally" to all SWOs, they would be best served by offering geographic stability and homeport. However, if the Navy offered geographic stability and homeport to all SWOs, some would accept the incentive but receive a value that is less than the Navy's cost; it would not be cost effective for the Navy to offer geographic stability and homeport to these SWOs. At the same time, there are some SWOs that value telecommuting and sabbaticals more than it costs the Navy's provide them. The Navy would omit a cost-effective incentive if it did not offer telecommuting and sabbatical to these SWOs.

To summarize, the Navy is maximizing cost-effectiveness by creating individualized incentive packages that offer NMIs to any SWO whose value exceeds the Navy's cost. The benefit achieved by such individualized incentive packages is the area below the value line and above the cost line, as shown in Figure 3.

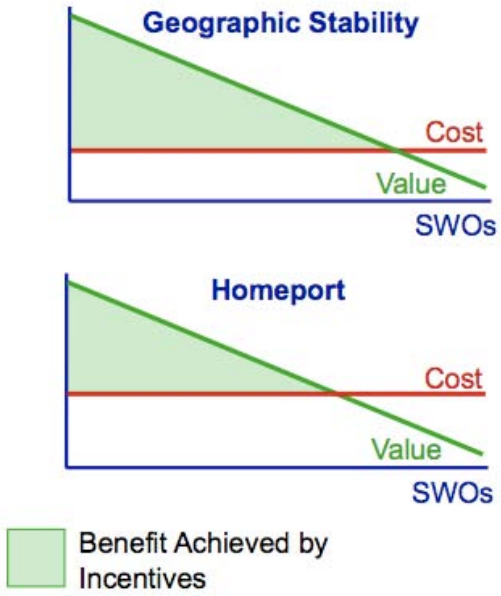

Figure 3. Benefit Achieved by Incentives (From Coughlan and Gates, 2007)

D. SECOND-PRICE SEALED BID AUCTION TRUTH REVEALING

In a sealed bid auction, bidders submit bids and but no bids are revealed until the winner is announced. In a second-price auction, the winner of the auction is the highest bidder, but the price paid by the winner is the amount bid by the next highest bidder (or first excluded bidder if there are multiple winners). Truth revealing refers to the optimal bidding strategy of a second-price sealed bid auction; the optimal strategy in such an auction is bidding ones true value. For further discussion and examples of truth-revelation in second-price sealed bid auctions, refer to previous research conducted by Brooke M. Zimmerman in 2008 from NPS.[20]

E. COMBINATORIAL RETENTION AUCTION MECHANISM (CRAM)

The CRAM incorporates three elements—each serves a separate purpose:

(1) Second Price Auction provides accuracy in setting bonus level;

[20] Brook M. Zimmerman, "Integrating Monetary and Non-Monetary Reenlistment Incentives Utilizing the Combinatorial Retention Auction Mechanism (CRAM)" (master's thesis, Naval Postgraduate School, 2008).

(2) Incorporating NMIs reduces the Navy's cost to retain an individual when that individual's value > cost for that NMI;

(3) Combinatorial auctions provide individualized incentive packages with no "wasted" incentives.[21]

In applying CRAM to SWO retention issues, the Navy offers the same NMIs to all SWOs. However, each SWO only receives the NMI if their value of the incentive exceeds cost. The SWO must express a willingness to pay for the incentive that exceeds the Navy's cost to provide the incentive.

1. Definition

In the CRAM auction, each SWO bids the minimum monetary incentive required if the retention incentive was cash-only. Additionally, the SWO indicates how much that cash bonus could be reduced for each NMI, if that NMI were included in his retention package. After receiving the bids, the auctioneer calculates the minimum cost package required to retain each SWO. Each minimum cost package includes any NMIs where the SWOs value exceeds the Navy's cost. To calculate the amount of cash bonus the SWO receives, the required cash-only bonus is reduced by the SWOs stated value of each NMI in the initial bid. The Navy's total cost of those incentives is then added to the provisional cash bonus to derive the Navy's total cost of the package bid. That is:

Navy Cost=Required cash only bonus–Value of awarded NMIs+Cost of awarded NMIs

SWOs with the lowest cost to the Navy are retained. The SWOs retained receive an incentive package that includes their NMI package plus a cash bonus that equals the Navy's effective cost for the first excluded bid minus the Navy's cost of his incentive package.[22] That is:

Cash Bonus=Navy Cost of first excluded bid–Navy cost of Sailor's awarded NMIs

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[21] Peter J. Coughlan, William R. Gates and Brooke M. Zimmerman, "The Combinatorial Retention Auction Mechanism (CRAM): Integrating Monetary and Non-Monetary Re-Enlistment Incentives."

[22] Ibid.

2. Example

Sailor #	Min. $ to Retain	Incentive 1 Value	Incentive 2 Value	Total Incentive Cost	Total Incentive Value	Revised Min. $ to Retain	Total Cost to Retain	Cash Bonus	Total Value Received
1	$80K	$40K	$10K	$20K	$40K	$40K	$60K	$60K	$100K
2	$90K	$10K	$30K	$20K	$30K	$60K	$80K	-	-
3	$100K	$30K	$40K	$40K	$70K	$30K	$70K	$40K	$110K

- Suppose Navy wants to retain 2 out of these 3 sailors
- Outcome with cash bonus only under 2nd-price auction
  - Each retainee receives 1st-excluded cash bid = $100K
  - Total cost to retain = 2 × $100K = $200K
  - Total surplus for retainees = ($100K - $80K) + ($100K - $90K) = $30K
- Suppose cost to Navy of each of 2 non-monetary incentives = $20K
- Outcome with Combinatorial Retention Auction Mechanism (CRAM)
  - Cost per retainee = 1st-excluded total cost to retain = $80K
  - Total cost to retain = 2 × $80K = $160K
  - Total surplus for retainees = ($100K - $80K) + ($110K - $100K) = $30K

Figure 4. Example: CRAM (From Coughlan and Gates, 2007)

Figure 4 explains the retention outcome of three sailors through the use of CRAM. What this example proves is that CRAM lowers the cost of retention for the Navy while not sacrificing individual sailor's value received. For further explanation of CRAM through examples, refer to Appendix A.

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IV. EXPERIMENT DESIGN

A. BACKGROUND

The first thing to say about economic experiments is what they are not. Economic experiments are not simulations or role-playing exercises. They involve real people who must make serious choices. Their decisions in the laboratory are as acute and as poignant as those made outside the laboratory. Through their efforts, participants stand to make or lose a substantial amount of money.[23]

B. EXPERIMENTAL ECONOMICS

Academics define economics as the branch of social science that deals with the production, distribution and consumption of goods and services and their management.[24] As with all sciences, the field of economics is observable. Economics is a science filled with complicated and naturally occurring systems. Economists observe market behaviors to include human choice behavior, and develop their own theories and models to explain how and why various market conditions occur. Economists base their theories on statistical data compiled from what they call "natural" markets. In turn, they develop their models to test their theories as predictors for future market conditions and individual choice behavior. The problem with basing theories on "natural" markets alone is that the data "often fail to allow 'critical tests' of theoretical propositions, because distinguishing historical circumstances occur only by change.[25]" By running controlled laboratory experiments, economists are able to see if their theories match observed individual human behavior.

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[23] Don Coursey, *Vernon Smith, Economic Experiments, and the Visible Hand*, October 28, 2002, http://www.econlib.org/library/Columns/CourseyVSmith.html (accessed October 15, 2009).

[24] Princeton, *Word Net Search*, http://wordnetweb.princeton.edu/perl/webwn?s=economics (accessed October 15, 2009).

[25] Douglas D. Davis and Charles A. Holt, *Experimental Economics* (New Jersey: Princeton University Press, 1993).

By running experiments under controlled laboratory conditions, economists overcome the problem of naturally occurring data. The benefits to running economic experiments are that they "can be an inexpensive way to study or explain behavior, examine certain economic policies, evaluate performance in institutions, and design better economic incentives.[26]" Experiments show human behavior in market conditions when past data alone cannot be used as a predicator or when market situations are too complicated to be revealed by natural markets.

C. TYPES OF EXPERIMENTS

There are several examples of economic experiments that economists use in their research methods. The three main types of economic experiments are individual decision theory experiments, game theory experiments, and price theory experiments. While there is some overlap between the three categories, each presents its own distinct purpose to economic experiments.

1. Price Theory Experiments

The supply and demand curve model is the most basic model used by economists to teach others how markets work. The supply and demand model illustrates how prices are determined in different types of markets. In a price theory experiment, sometimes revered to as a market theory experiment, price and quantity predictions are determined by where the supply curve meets the demand curve.

[26] Willian J. Norton, "Using an Experimental Apporach to Improving the Selective Reenlistment Bonus Program" (master's thesis, Naval Postgraduate School, 2007).

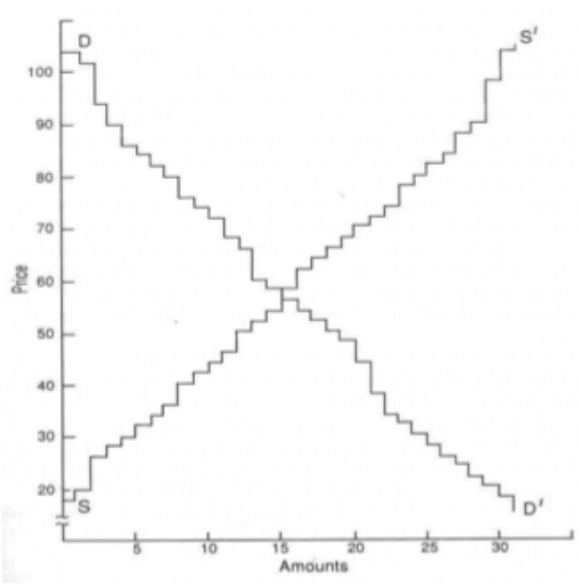

Figure 5. Supply and Demand Curves (From Norton, 2007)

The following illustrates a price theory experiment conducted by Vernon L Smith, an economist at Chapman University. First, Smith started off with a simple price theory experiment titled a two-person exchange that involves a single buyer and a single seller. In the experiment, the two come to an agreement, or not, on the price of an object. The professor assigns the cost and value, represented by a card given to the buyer and the seller. For example, the seller is given a card specifying that the cost of production for the object is, say, $5. Any price the seller receives above $5 will result in profit. The Buyer similarly receives a card stating that the resale value of the object is, say, $15. In this situation, one of two outcomes will occur, either the seller and buyer will come to an agreement between $5 and $15 or they will not reach an agreement and a transaction will not occur.[27]

The simple experiment between two individuals can be expanded for more complex market situations. Suppose instead there are five buyers and five sellers and each is given a card with different costs and values. Smith conducted these experiments using a "double-oral-auction." This auction makes buyer and sellers publicly declare

[27] Don Coursey, *Vernon Smith, Economic Experiments, and the Visible Hand*, October 28, 2002, http://www.econlib.org/library/Columns/CourseyVSmith.html (accessed October 15, 2009).

their bids. Smith used an important rule, called the bid-asked-price-reduction-rule meaning that sellers called and publicly posted asking prices.[28] All announced asking prices must descend from the original asking price. The buyers had to do the same, though bids must ascend from the starting bid price. Trade occurs in two ways, either a seller accepts any buyer's bid or a buyer accepts any seller's asking price. The experimental results showed that the price always reached equilibrium where the demand curve met the supply curve.[29]

2. Game Theory Experiments

Game theory describes a class of mathematical models describing the interaction of rational agents.[30] Game theory experiments deal with individuals and the choices they make. The rules for the game are set and the success of the individual depends on their choices and the choices of others. The best example to explain game theory experiments is the prisoner's dilemma.

Suppose two individuals, Mike and John, have committed a serious crime, but were arrested for a lesser offense. Police officers take the two criminals to different rooms and interrogate them. The police have enough evidence to convict the criminals on the lesser offense, but not the serious crime. The cops give each of them the same deal, implicate the other in the serious crime and they will receive a reduced sentence. If Mike confesses to the serious crime and John does not, Mike will get no sentence and John will receive a ten-year sentence. The opposite is true if John confesses and Mike does not. If they both confess they will each get six-year sentences. If neither of them confesses, they will each get two years.

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[28] Don Coursey, *Vernon Smith, Economic Experiments, and the Visible Hand*, OCT 28, 2002, http://www.econlib.org/library/Columns/CourseyVSmith.html (accessed October 15, 2009).

[29] Ibid.

[30] Douglas D. Davis and Charles A. Holt, *Experimental Economics* (New Jersey: Princeton University Press, 1993).

	Confess A	Stay quiet A
Confess B	6 6	10 0
Stay quiet B	0 10	2 2

Figure 6. Prisoner's Dilemma

Mike wants to make the best deal for himself, but he is unsure of what John will do. Clearly, both prisoners will be better off if neither of them confesses, each serving only two-years in prison. Since neither player knows what the other will do, hence the dilemma, the best or dominant strategy is to confess. A dominant strategy is a strategy that is best for a player regardless of the other players' strategy.[31] In this case, if John confesses, Mike should confess too because his sentence will be six years instead of ten. If John does not confess, Mike's best option is to still confess because he will serve no time instead of two years. A prisoner's dilemma pricing problem can be used to describe oligopoly market situations or cases with few competing firms.

3. Individual Decision Theory Experiments

Decision theory is a branch of statistical theory concerned with quantifying the process of choosing between alternatives.[32] Decision theory focuses on individuals indentifying the best decision to make when presented with a list of choices containing

[31] Robert E. Hall and Marc Lieberman, *Economics: Principles and Applications*, 4 (Mason, OH: Thomson Higher Education, 2008).

[32] *Merriam-Webster Online Dictionary*, http://www.merriam-webster.com/dictionary/decision%20theory (accessed October 15, 2009).

uncertainty. These choices lead to an expected value that the individual tries to maximize, but not all individuals act the same. There are two types of individuals, adverse and risk neutral individuals. Risk adverse individuals will take a lower expected value for less risk. Risk neutral individuals are only concerned with gaining the highest expected value, regardless of the risk involved.

An example of this can involve a person given two scenarios. One scenario has a guaranteed payoff, say $10. The other scenario involves flipping a coin for a payoff. If the coin lands on tails, the individual receives $25. If the coin lands on heads, the individual receives nothing. An individual would receive $10 guaranteed from the first scenario and an expected value of $15.50, $25 x .5 + $0 x .5 = $12.50, for the coin flipping scenario. A risk adverse individual might take the guaranteed $10 payment because it contains no risk; a risk neutral individual would try to maximize his returns and take the coin flip with an expected value of $12.50.

Individual decision theory is important to the Department of Defense because it deals with individual behavior when faced with uncertainty. The theory helps to analyze situations when looking at expected value, such as the individuals' risk traits in choosing between being retained by the armed services and venturing into the private sector; or questions such how military members will respond in retention auctions when faced with uncertainty regarding others bidding strategies.

D. DESIGNING EXPERIMENTS

When conducting experiments in a laboratory, there are advantages and limitations. The two main advantages in conducting laboratory experiments are replicablity and control. Replication improves experimental results by allowing several groups to partake in the experiment. Replication reduces variability in experimental results and increases the significance and confidence levels with which a researcher can draw conclusions about an experimental treatment.[33] Control is the ability to manipulate laboratory conditions so that observed behavior can be used to evaluate alternative

[33] *Experimentation Definitions*, http://www.stat.yale.edu/Courses/1997-98/101/expdes.htm (accessed October 15, 2009).

theories and policies.[34] Properly controlling variables and the testing environment eliminates inaccuracies and misconceptions that could result if there was no control.

Conversely, experiments do have limitations. The most common limitation in running experiments is that they fail to develop an alternative hypothesis when evaluating a primary hypothesis. An experiment can only prove or disprove a primary hypothesis or theory. If a theory is proven wrong by an experiment, a new theory must be formulated and a new experiment administered.

E. SUMMARY

Economists typically use experiments to gather information to verify theories they can then use to build models. Economists use experiments and models to explain how and why various decisions are made and examine the resulting impacts. While there are some disadvantages to running experiments, there are a significant number of advantages.

[34] Douglas D. Davis and Charles A. Holt, *Experimental Economics* (New Jersey: Princeton University Press, 1993).

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V. ADMINISTRATION OF SECOND-PRICE SEALED BID EXPERIMENT

A. INTRODUCTION

LT Amanda Browning and LT Clinton Burr ran a pilot experiment on two NPS economics classes in November 2009 using a second-price sealed bid auction. The experiment format consisted of two stages. The first stage was an experiment with cash bids only. The second stage of the experiment involved a cash bid plus bids for NMIs. This chapter details the experimental procedures. The entire experiment is provided in Appendices B-D.

B. EXPERIMENTAL OVERVIEW

The goal of the experiment was to determine if subjects bid their true value for monetary and non-monetary incentives. The experiment design placed subjects in a hypothetical salary survey and then added in a non-monetary compensation salary option. The experimenters ran the experiment on two sets of subjects. Both sets of subjects participating in the experiment involved 19 students. The experiment was a paper experiment in which the experimenters set the pace by reading all instructions aloud and instructing when to commence each phase. Appendix B is the actual experiment received by the subjects. Appendices C and D are the experiment instructions and visual examples. After each round of salary bid submission, experimenters calculated and showed the results to the subjects. After compiling the data, the experimenters debriefed the subjects on the results.

1. Initial Cash Bid Only

In the initial cash bid only experiment scenario, there were two firms in which the subjects could work, Firm A or Firm B. Firm A is downsizing by 50% (ten employees). The only other employer to the subject is Firm B. Subjects have no preference between working for either Firm A or Firm B. The subject's only goal is to maximize their

income. If Firm A does not retain the subject, they will begin to work for Firm B immediately. Firm B presents a confidential salary offer to Firm A employees. Subjects know from the instructions that the offers from Firm B are spread evenly and randomly between some range and that their offer is somewhere within that range. The subjects then submitted a salary bid to Firm A. Their salary bid is the minimum annual salary necessary to remain at Firm A. Based on the salary submissions, Firm A then retains the ten employees with the lowest salary bids while those not retained are immediately laid off and begin working for Firm B. Those retained at Firm A all receive the same annual salary equal to the lowest salary of the 50% of employees laid off (i.e., the first excluded bid). Those employees laid off immediately begin working for Firm B at the salary Firm B offered to them.

2. Cash Bid Plus NMIs

In the cash bid plus NMIs experiment scenario, there are still two firms in which the subjects could work, Firm A or Firm B. In this scenario, everything is the same except that now Firm A offers two NMIs that Firm B does not offer. Firm A asks all of its employees to specify the minimum annual salary they require to remain with Firm A. Then, Firm A asks how much the subjects would be willing to give up from that salary for each NMI. The subjects only receive the NMI if their bid for the NMI is greater than Firm A's cost of the NMI. Firm A will retain 50% of the subjects. The employees laid off immediately begin working at Firm B at the salary offered. The remaining employees continue to work for Firm A and receive those NMIs where their bid was greater than the NMI cost to Firm A. Those employees retained by Firm A received a salary equal to the base salary minus the cost of any NMIs they received. The base salary is the lowest salary of the 50% of employees laid off.

C. RESULTS

During the actual experiment and for the ease of computation while in the classroom, if a tie occurred, Firm A retained both subjects and the next highest bid was the salary paid. However, for the sake of analyzing the data, the experimenters used a

random tiebreaker to determine who won the tie and only retained ten subjects in every round (ensuring the same retention rates across all trials). The experimenters independently analyzed the data from both sets of experiments, referred to as Experiment 1 and Experiment 2.

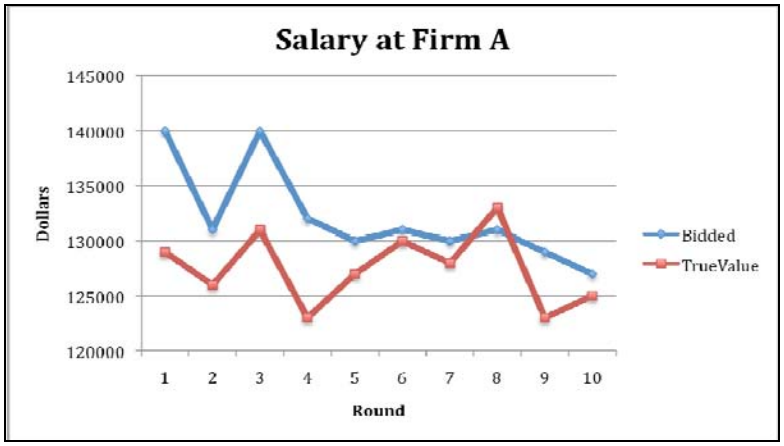

Figure 7. Salary at Firm A, Experiment 1

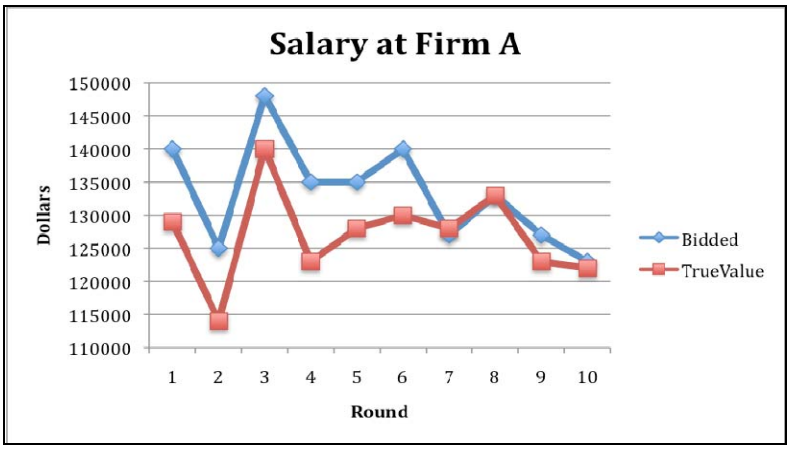

Figure 8. Salary at Firm A, Experiment 2

Figures 7 and 8 show the results for the cash bid only portion of the salary survey. The bidded line represents the average dollar amount each subject bid during each round of the experiment. The true value line shows the average salary offered by Firm B to each subject during each round of bidding. Figure 7 round 8 shows that the subjects tried

to game the survey and bid low to ensure retention by Firm A, but they could have received a higher average salary if they bid their true value for retention.

Figures 21 to 28 are located in Appendix E and show how close to true value each subject bid for each experiment during the first, second, ninth, and tenth round of the experiment. The line bisecting the graph is the equilibrium line, or the true value for each round of bidding. The closer to the line, the closer the subjects bid to their true value. If the data point is below or above the line, the subject bid that amount different than their true value. By showing the first, second, ninth, and then tenth rounds, we show that with the exception of a few outliers per experimental group, learning occurred as subjects began to bid closer to their true value.

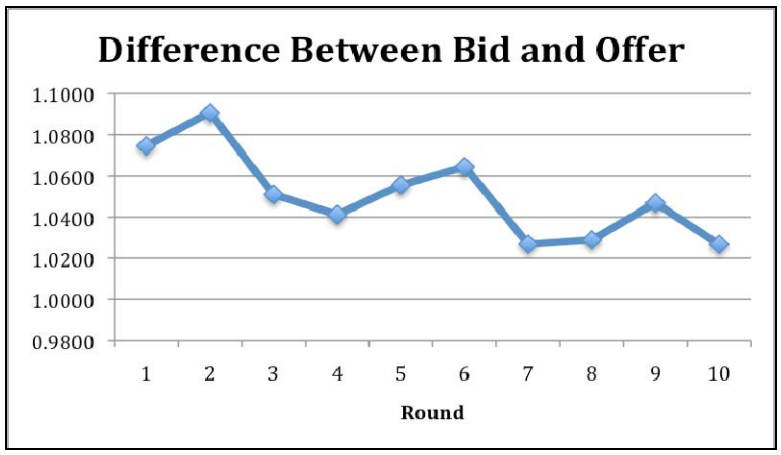

Figure 9. Difference Between Bid and Offer, Experiment 1

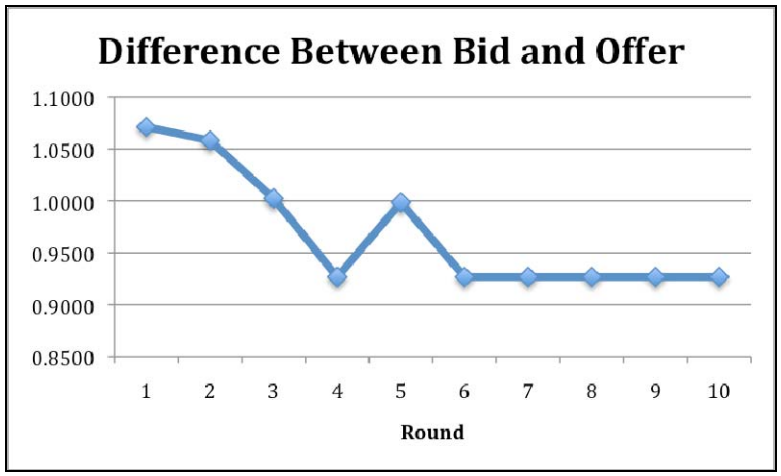

Figure 10. Difference Between Bid and Offer, Experiment 2

Figures 9 and 10 also show that learning occurred. They illustrate the difference between what the subjects bid and the salary Firm A offered, shown as an average percentage for each round of bidding. A value of 1.000 indicates that the average of the bids were at true value. If the round is above 1.0000, the rounds average bids were above the true value; if below 1.000, the opposite is true. Figure 9 shows that the first class taking the experiment definitely learned occurred because the average approaches 1.0000 over the course of ten rounds. Although Figure 10 does not show a line approaching 1.0000, we think this could reflect that two subjects in the second experiment group continuously tried to game the system by bidding $1 and $0.

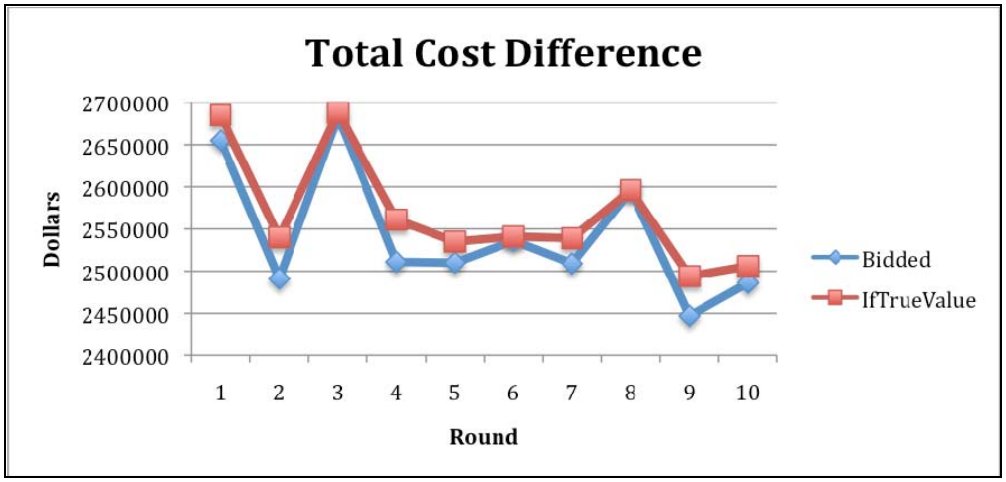

Figure 11. Total Cost Difference, Experiment 1

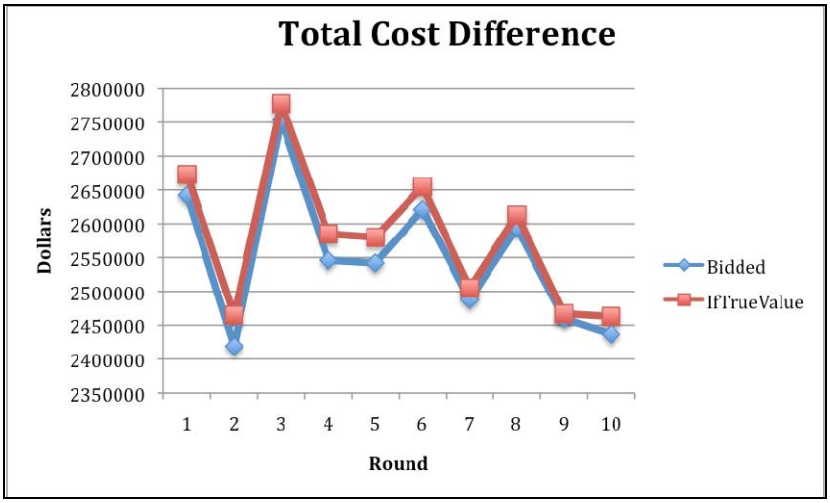

Figure 12. Total Cost Difference, Experiment 2

Figures 11 and 12 show the difference in the total average cost per round between the bidded value and the value if the subjects bid their true value. The blue line represents the total salary paid per round based on the subject bids. The red line represents the total salary that would have been paid if all subjects bid their true value. Figures 11 and 12 prove that the optimal strategy is to bid ones true value because the subject does as well or better, but never worse, if they bid their true value for each round of bidding.

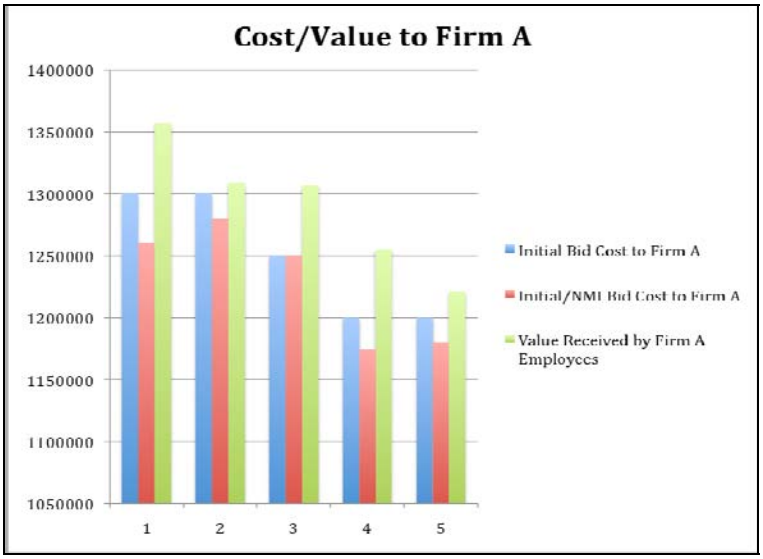

Figure 13. Cost vs. Value to Firm A, Experiment 1

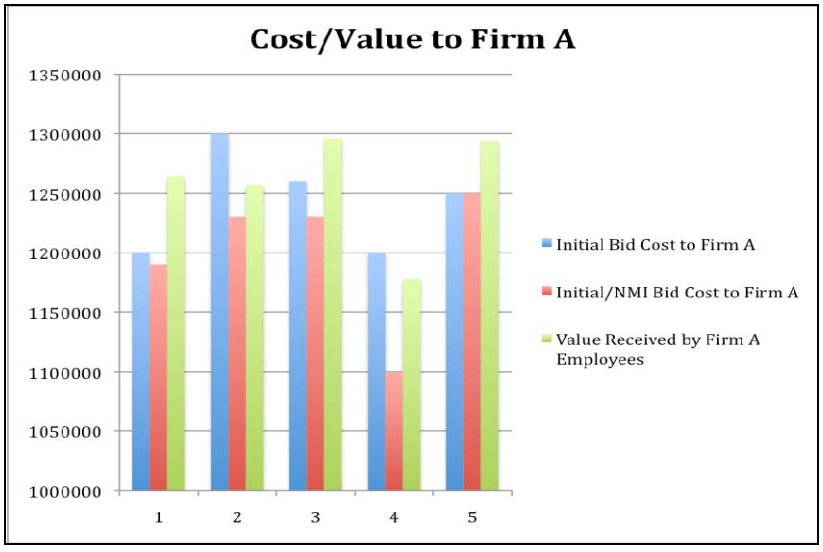

Figure 14. Cost vs.Value to Firm A, Experiment 2

Figures 13 and 14 are from data obtained through the cash bid plus NMI portion of the experiment. The graph illustrates the differences in costs and value for each round if each subject bid truthfully. In each round, it is less expensive or of equal cost to Firm A to offer NMIs; value to the bidders increases significantly in all but one round (round 4, experiment 2). In that round, offering NMIs reduced the firm's retention costs enough that the bidders' received a slightly lower value.

D. CONCLUSION AND RECOMMENDATION FOR FURTHER STUDY

The purpose of this thesis was to use an experimental approach to examine the decisions making process SWOs might use when choosing between monetary and non-monetary retention bonuses. We expected to observe that experimental subjects would choose incentives that maximize their personal retention value by combining monetary and non-monetary incentives. The goal was to help create a mechanism that combines monetary and non-monetary incentives that reduce retention bonus cost to the Navy while maximizing individual self-value.

During our experiment, we found that value was always greater than cost when incentives were provided correctly. When an individual placed more value on a non-monetary incentive than the cost of that incentive, cost to be retained decreased. Also, when compared to cash alone, the cost to retain became lower when providing non-monetary incentives. Referring to Figures 13 and 14 from the previous chapter, cost to retain was always higher than the cost of just monetary incentives. Non-monetary incentives help drive down cost when an individual values the service more than the cost. The company retaining individuals, Firm A, absorbs the benefit of the difference between cost and value with no harm to the individual.

In our experiment, when non-monetary incentives were applied, value for Firm A employees was greater than cash alone 80% of the time. While this experiment was just a pilot, we conclude that adding non-monetary incentives creates more value to individuals than cash alone while also reducing the cost to retain employees.

The experiment met our goal of helping to form a retention mechanism that creates the same or greater value to individuals at a lower cost to the Navy. While the

experiment was a pilot, it proves that when individuals value a non-monetary incentive more than the cost to provide that incentive, both the Navy and the individual are better off.

1. Recommendations

During the experiment, we noted several improvements to create a more efficient experiment environment to produce better data. One improvement will come from designing the experiment using a computer application and then administrating it on a computer. This will save a significant amount of time in that paper bids will not have to be collected and counted. Individuals will not have to sit and wait while they are notified if they are retained or not. Information would flow much faster using a computer-based system.

Another improvement can be larger values for non-monetary incentives and larger salaries. Having larger amounts for non-monetary incentives will help show the impact they create in graphs and statistical data. This in turn might help observers see the strength in cost savings when analyzing the data from an experiment.

Additionally, the instructions and examples (provided in Appendix C and D) were inefficient for explaining the experiment. Even though it appears that learning did occur over the course of the experiment, the authors recommend further research to ease the confusion of the model and to make implementation of the model more accurate and possible on a large scale. Though this paper focused primarily on the issues surrounding SWO retention, the CRAM model, if implemented properly and with accurate cost data, could help discover the optimal incentive package for retention of a larger, more diverse sample of military fields.

2. Further Research

We recommend further research into CRAM experiments, focusing on value creation through non-monetary incentives. Computer based experiments would greatly enhance the speed and substance of the experiments. Also, we recommend running experiments stating what the non-monetary incentives are (homeporting, type of ship,

etc.) as well as disclosing the cost of the non-monetary incentive before submitting bids. Lastly, we recommend running experiments with a menu type options were individuals can choose what non-monetary incentives they would like from a group, thus seeing behavioral actions when able to fully customize retention package.

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APPENDIX A: COMBINATORIAL RETENTION AUCTION MECHANISM (CRAM)

A. OVERVIEW

The CRAM incorporates three elements—each serves a separate purpose:

(1) Second Price Auction provides accuracy in setting bonus level;

(2) A NMI reduce the Navy's cost to retain a Sailor when that Sailor's value > cost for that NMI;

(3) Combinatorial auctions provide individualized incentive packages with no "wasted" incentives.[35]

Under the CRAM, a retained Sailor receives a particular NMI only if he expresses a willingness to pay for the incentive that exceeds the Navy's cost to provide the incentive. This eliminates the need to determine which incentives to offer; all incentives are offered to all Sailors and allocated to those whose value exceeds cost. For those NMIs whose cost varies significantly depending on the number of participants, there are a number of variations of the CRAM which can be adopted to accommodate varying (presumably increasing) unit costs. This includes using equilibrium prices (where the supply or marginal cost curve intersects the demand or value curve), average costs or quantity limits (quotas) for each NMI (these options will not be discussed in detail here).

B. PROCESS DESCRIPTION

The CRAM Auction is very similar to the auctions used for monetary retention and the Universal Incentive Package described above. Each Sailor bids the minimum selective re-enlistment bonus (SRB) he would require if the retention incentive were cash-only. Each Sailor also indicates how much his cash bonus could be reduced for each NMI if that NMI were included in his retention package.

[35] Peter J. Coughlan, email message to the author, November 2, 2008.

After receiving these bids, the auctioneer calculates the minimum cost package required to retain each Sailor. Each minimum cost package includes any NMI where the Sailor's value exceeds the Navy's cost. To calculate the Sailor's provisional cash bonus, the Sailor's required cash-only bonus is reduced by the NMI value stated in the initial bid for any NMI offered that Sailor. The Navy's total cost of those incentives is then added to the provisional cash bonus to derive the Sailor's "effective" cost to the Navy—or the Navy's total cost of the package bid.

After calculating each Sailor's minimum cost retention package, lowest cost Sailors are retained. Each retained Sailor receives their individualized NMI package plus a cash bonus that equals the Navy's effective cost for the first excluded bid minus the Navy's cost of his incentive package. Note that the Navy's total retention cost is the same for every retained Sailor. Each Sailor receives a personalized NMI package and values the incentives differently, so the value of the retention incentive varies across Sailors. The value each Sailor receives from their retention package equals or exceeds the Navy's retention cost; in many cases a Sailor's value significantly exceeds the Navy's cost.[36] Furthermore, the value for each retained Sailor's retention package exceeds their cash-only bonus requirement.

C. PROCESS EXAMPLE

In the example illustrated by Figure 15, three Sailors truthfully bid their minimum required cash-only SRB, given that this is a generalized second-price auction, and each states the dollar amount of that bonus he would sacrifice for each of the 2 available NMIs; each NMIs is assumed to cost the Navy $20,000 per Sailor. Each Sailor's minimum cost bid package includes any NMI for which his value exceeds cost. Given the values shown in Figure 15, Sailor 1's bid package would include incentive 1; Sailor 2's bid package would include incentive 2; and Sailor 3's bid package would include both incentives. The auctioneer then calculates a revised minimum cash retention bonus. This is the original cash bonus bid minus the sum of the stated values for each NMI included

[36] Peter J. Coughlan and William Gates, "Monetary and Non-Monetary SWO Retention Bonuses: The Combinatorial Retention Auction Mechanism (CRAM)" (lecture, Naval Postgraduate School, Monterey, CA, May 6, 2007).

in the bid package. Each Sailor's minimum cost to retain is then this revised minimum cash bonus plus the total cost of any NMIs included in the bid package.

Sailor #	Min. $ to Retain	Incentive 1 Value	Incentive 2 Value	Total Incentive Cost	Total Incentive Value	Revised Min. $ to Retain	Total Cost to Retain	Cash Bonus	Total Value Received
1	$80K	$40K	$10K	$20K	$40K	$40K	$60K	$60K	$100K
2	$90K	$10K	$30K	$20K	$30K	$60K	$80K	-	-
3	$100K	$30K	$40K	$40K	$70K	$30K	$70K	$40K	$110K

Figure 15. Enlisted Retention Example: CRAM (From Coughlan and Gates, 2007)

As shown, if the Navy plans to retain two of these three Sailors, Sailors 1 and 3 would be retained as they have the two lowest retention costs. Each of the retained Sailors would receive the NMIs included in their bid package; each also receives a cash bonus equal to the total "effective" cost of the first excluded bid ($80,000 in the example) minus the Navy's total cost of the NMIs included in that package.

D. THE ADVANTAGE OF CRAM

The example in Figure 15 illustrates the money-saving potential of the CRAM Auction. Under a second-price retention auction with monetary incentives alone, Sailors 1 and 2 would be retained for a cash bonus equal to the first excluded cash bid; the $100,000 bid submitted by Sailor 3. Thus, the total cost to retain two Sailors under a cash bonus is $200,000. Under the CRAM, Sailors 1 and 3 would each be retained at a cost equal to the total cost of the first excluded package bid. This cost is the Navy's $80,000 effective cost associated with Sailor 2's minimum cost package bid. Thus, the total cost to retain two Sailors under CRAM is $160,000.

Compared to the purely cash retention auction, CRAM retains the same number of Sailors but reduces the total cost to the Navy. In addition, CRAM potentially increases the Sailors' surplus. The mechanism substitutes cash SRB payments with individualized NMI packages when individuals state a willingness to pay that is no less than the Navy's

cost, but the Sailors cash bonus is only reduced by the Navy's NMI cost. As a result, each Sailor's surplus equals or exceeds their surplus under the cash only auction, but at a lower cost to the Navy: a true win-win situation.

Compared to the Universal Incentive Package (UIP), CRAM increases efficiency by enabling the Navy to capture the surplus represented by the green triangles in Figure 16, but eliminating the Navy's potential waste associated with the red triangles under the UIP. CRAM further increases efficiency by capturing the surplus from incentives not offered under the UIP, as represented by the blue triangles in Figure 16.

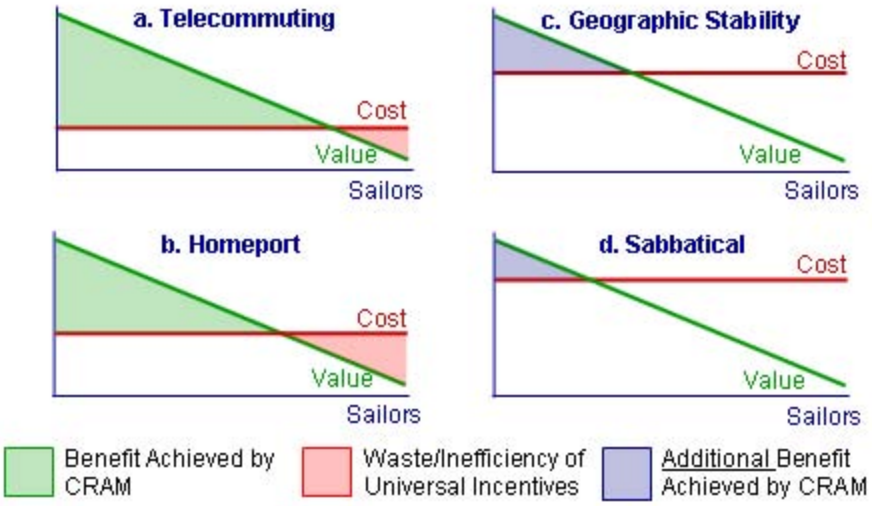

Figure 16. CRAM overcomes the Universal Package Weakness
(From Coughlan and Gates, 2007)

Further, CRAM eliminates the difficulties involved in identifying the optimal UIP: truthful revelation of the NMI values, identifying the relevant (retained) population of Sailors, and predicting the actual NMI usage rate. Finally, CRAM potentially changes the "mix" of Sailors retained. In the example above, Sailors 1 and 2 were retained under a strictly monetary retention auction; Sailors 1 and 3 were retained under CRAM.

APPENDIX B: EXPERIMENT

A. SURVEY–CASH BID

EMPLOYEE ID:_____

SCENARIO BACKGROUND

You are an employee of Firm A. The other students in the classroom are also employees of Firm A. There are no other employees in Firm A besides the students in the classroom.

Your only other potential employer is Firm B.

You have no particular preference between working for Firm A or for Firm B.

You can easily switch employers at no cost or inconvenience to you.

Your only goal is to maximize your total income.

DOWNSIZING AT FIRM A

Firm A is downsizing. 50% of Firm A's workforce will be laid off immediately.

EMPLOYMENT OFFER FROM FIRM B

Firm B has offered to employ anybody who leaves Firm A. If you leave Firm A now, you will work for Firm B immediately.

This standing offer of employment at Firm B applies whether you leave Firm A voluntarily or if you are laid off.

SALARY OFFER FROM FIRM B

Firm B has presented a confidential annual salary offer to each employee currently working for Firm A.

The offer presented to each employee (each student in the classroom) represents the annual salary that he/she will receive if employed by Firm B.

Firm B has offered a different annual salary amount to each Firm A employee.

DISTRIBUTION OF SALARY OFFERS FROM FIRM B

You do not know the salary amounts that Firm B has offered to other current employees at Firm A. You know only that all of Firm B's salary offers are spread evenly and randomly over some range between some lower bound and some upper bound. You do not know the actual lower and upper bounds of the range of salaries offered. However, you do know that the salary offered to you by Firm B lies somewhere within this range of offers.

SALARY SURVEY AT FIRM A

The salary paid to any Firm A employee in previous years will have no influence on his/her future salary at Firm A. Instead, the annual salary that Firm A will pay to each of its retained employees will be determined using a survey.

Firm A is asking all its employees (all students in the classroom) to specify the minimum annual salary that he/she would need to receive in order to remain with Firm A. Firm A will then pay the minimum salary necessary to voluntarily retain 50% of its employees. In particular, after collecting all "salary requests" from its employees, Firm A will lay off the 50% of employees who submitted the highest salary requests.

The employees laid off (50% of current Firm A employees) will immediately begin working at Firm B at the salary offered. The remaining employees will continue to work for Firm A.

All employees retained by Firm A will be paid the same salary, regardless of the salary they requested. These retained employees will be paid the lowest salary from the 50% of employees laid off.

Note that this salary will be higher than the salary requested by any of the retained employees.

YOUR SALARY REQUEST TO FIRM A

You must now decide what annual salary to request from Firm A.

Remember that if your request is among the highest 50% of the salary requests submitted, you will be laid off from Firm A and will immediately work for Firm B.

If your salary request to Firm A is not among the highest 50%, you will continue to work for Firm A and will receive an annual salary equal to the lowest salary requested from the 50% of employees not retained.

SALARY OFFERS FROM FIRM B

Under each of the post-it notes below, you will find a salary offer from Firm B. The number on each post-it note represents each round of bidding. You cannot share with other employees your offer from Firm B.

Salary Offer from Firm B	Salary Offer from Firm B
_____	_____
Salary Offer from Firm B	Salary Offer from Firm B
_____	_____
Salary Offer from Firm B	Salary Offer from Firm B
_____	_____
Salary Offer from Firm B	Salary Offer from Firm B
_____	_____

Salary Offer from Firm B Salary Offer from Firm B

_____ _____

B. SURVEY–CASH BID PLUS NON-MONETARY INCENTIVES

EMPLOYEE ID:_____

SCENARIO BACKGROUND

You are an employee of Firm A. The other students in the classroom are also employees of Firm A. There are no other employees in Firm A besides the students in the classroom.

Your only other potential employer is Firm B.

You have no particular preference between working for Firm A or for Firm B.

You can easily switch employers at no cost or inconvenience to you.

Your only goal is to maximize your total income (monetary and non-monetary benefits/income)

DOWNSIZING AT FIRM A

Firm A is downsizing. 50% of Firm A's workforce will be laid off immediately.

EMPLOYMENT OFFER FROM FIRM B

Firm B has offered to employ anybody who leaves Firm A. If you leave Firm A now, you will work for Firm B immediately.

This standing offer of employment at Firm B applies whether you leave Firm A voluntarily or if you are laid off.

SALARY OFFER FROM FIRM B

Firm B has presented a confidential annual salary offer to each employee currently working for Firm A.

The offer presented to each employee (each student in the classroom) represents the annual salary that he/she will receive if employed by Firm B.

Firm B has offered a different annual salary amount to each Firm A employee.

DISTRIBUTION OF SALARY OFFERS FROM FIRM B

You do not know the salary amounts that Firm B has offered to other current employees at Firm A. You know only that all of Firm B's salary offers are spread evenly and randomly over some range between some lower bound and some upper bound. You do not know the actual lower and upper bounds of the range of salary offered. However, you do know that the salary offered to you by Firm B lies somewhere within this range of offers.

NON-MONETARY INCENTIVES AT FIRM A

Firm A now offers two non-monetary incentives that Firm B does not offer.

You do no know the cost of these non-monetary incentives; you only know how you value each non-monetary incentive.

SALARY SURVEY AT FIRM A

The salary paid to any Firm A employee in previous years will have no influence on his/her future salary at Firm A. Instead, the annual salary that Firm A will pay to each of its retained employees will be determined using a survey.

Firm A is asking all its employees (all students in the classroom) to specify the minimum annual salary that he/she would need to receive in order to remain with Firm A. Once you determine your minimum annual salary to be retained, Firm A is then asking how much you would give up from that salary for each non-monetary incentive. You will only receive a non-monetary incentive if your bid for the non-monetary incentive is greater than the cost to Firm A.

Firm A will then pay the minimum salary necessary to voluntarily retain 50% of its employees. In particular, after collecting all "salary requests" from its employees, Firm A will lay off the 50% of employees who submitted the highest salary requests.

The employees laid off (50% of current Firm A employees) will immediately begin working at Firm B at the salary offered. The remaining employees will continue to work for Firm A and receive those non-monetary incentives where their bid is greater than the non-monetary incentive cost to Firm A.

All employees retained by Firm A will be paid a base salary minus the cost of any non-monetary incentives they will receive. The base salary will be the lowest salary from the 50% of employees laid off.

Note that this salary will be higher than the salary requested by any of the retained employees.

YOUR SALARY REQUEST TO FIRM A

You must now decide what annual salary to request from Firm A.

Your overall salary request to Firm A will be an initial salary, minus your bid for each NMI you receive where your bid is greater than cost to Firm A. Firm A will then calculate your cost to retain and use that as your competitive bid.

Remember that if your request is among the highest 50% of the salary requests submitted, you will be laid off from Firm A and will immediately work for Firm B.

If your salary request to Firm A is not among the highest 50%, you will continue to work for Firm A and will receive an annual base salary equal to the lowest salary requested from the 50% of employees not retained, plus any non-monetary incentives where your bid was greater than the cost. Actual cash salary will be the base salary minus the cost of any non-monetary incentives received.

SALARY OFFERS FROM FIRM B

Under each of the post-it notes below, you will find a salary offer from Firm B. The number on each post-it note represents each round of bidding. You cannot share with other employees your offer from Firm B.

NON-MONETARY INCENTIVES AT FIRM A

Also under each of the post-it notes below, you will find your value for each non-monetary incentive. This figure represents your value for each individual non-monetary incentive.

Salary Offer from Firm B

_____

NMI #1 Value_____

NMI#2 Value_____

Salary Offer from Firm B

Salary Offer from Firm B

_____

NMI #1 Value_____

NMI #2 Value_____

Salary Offer from Firm B

Salary Offer from Firm B

_____

NMI #1 Value_____

NMI#2 Value_____

Salary Offer from Firm B

Salary Offer from Firm B

_____

NMI #1 Value_____

NMI #2 Value_____

Salary Offer from Firm B

_____

NMI #1 Value_____

NMI#2 Value_____

Salary Offer from Firm B

_____

NMI #1 Value_____

NMI #2 Value_____

Salary Offer from Firm B

_____

NMI #1 Value_____

NMI#2 Value_____

Salary Offer from Firm B

_____

NMI #1 Value_____

NMI#2 Value_____

Salary Offer from Firm B

_____

NMI #1 Value_____

NMI #2 Value_____

Salary Offer from Firm B

_____

NMI #1 Value_____

NMI #2 Value_____

APPENDIX C: EXPERIMENT INSTRUCTIONS

A. CASH BID

Welcome. Please do not touch anything in front of you until you are instructed to do so. In front of you, there is a white piece of paper entitled "Experiment Participant Registration Information." Please take a few minutes to fill in the requested information.

You are about to participate in an experiment in labor market decision-making. The entire experiment will take place in the classroom and your primary actions will involve submitting salary bids on separate pieces of paper. It is important that you do not talk or in any way try to communicate with other participants during the experiment.

During the instruction period, you will be given a complete description of the experiment and you will be introduced to the type of decisions you will be asked to make during the experiment. If you have any questions during the instruction period, raise your hand and your question will be answered so that everyone can hear. If any difficulties arise after the experiment has begun, raise your hand, and an experimenter will come and assist you.

The experiment itself will consist of 20 rounds. Rounds 1 through 10 will involve submitting salary bids involving monetary incentives. Rounds 11 through 20 will involve submitting salary bids involving monetary and non-monetary incentives. Instructions will be given for the first 10 rounds and then we will administer those 10 rounds of the experiment. Next, we will pass out what is needed for the second portion of the experiment. Then you will be given the instructions for the next 10 rounds and then we will administer rounds 11 through 20 of the experiment.

You should have three stacks of papers in front of you, a yellow stack, a blue sheet, and a stack of green sheets. Please turn your attention to the yellow sheets, which should say "Survey Cash Bid" at the top left hand side of the paper. As you can see, this paper contains an extensive description of the labor market scenario we are investigating in this experiment. I will read aloud all of the information that is written on your paper

and you should read along. Also note an employee ID at the top right of this paper. This will be your identification code throughout the remainder of the experiment.

You can use the yellow papers as a reference if you need it at anytime during the first 10 rounds. The first 10 rounds will have all the same information and scenario. It is simply provided as a reference in case you would like to go back and review the scenario description.

I will now begin reading the description on your yellow paper.

SCENARIO BACKGROUND

You are an employee of Firm A. The other students in the classroom are also employees of Firm A. There are no other employees in Firm A besides the students in the classroom.

Your only other potential employer is Firm B.

You have no particular preference between working for Firm A or for Firm B.

You can easily switch employers at no cost or inconvenience to you.

Your only goal is to maximize your total income.

DOWNSIZING AT FIRM A

Firm A is downsizing. 50% of Firm A's workforce will be laid off immediately.

EMPLOYMENT OFFER FROM FIRM B

Firm B has offered to employ anybody who leaves Firm A. If you leave Firm A now, you will work for Firm B immediately.

This standing offer of employment at Firm B applies whether you leave Firm A voluntarily or if you are laid off.

SALARY OFFER FROM FIRM B

Firm B has presented a confidential annual salary offer to each employee currently working for Firm A.

The offer presented to each employee (each student in the classroom) represents the annual salary that he/she will receive if employed by Firm B.

Firm B has offered a different annual salary amount to each Firm A employee.

This is not written on your yellow sheets of paper, but if you turn to the last page, you will find 10 post-it notes, each having a number written on it. Do not remove any post-it notes until I instruct you to do so. The number on the post-it note corresponds to the round of bidding taking place, 1 for round 1, 2 for round 2, etc. For each round, you will remove the post-it note for that round and that will be your salary offer from Firm B. Please do not remove any post-it notes for future rounds. Also, past rounds have no effect on the current round of bidding. Once a round is over, the last round salary offer has no consequence on future rounds of bidding.

Now, I will now continue reading the experiment.

DISTRIBUTION OF SALARY OFFERS FROM FIRM B

You do not know the salary amounts that Firm B has offered to other current employees at Firm A. You know only that all of Firm B's salary offers are spread evenly and randomly over some range between some lower bound and some upper bound. You do not know the actual lower and upper bounds of the range of salaries offered. However, you do know that the salary offered to you by Firm B lies somewhere within this range of offers.

SALARY SURVEY AT FIRM A

The salary paid to any Firm A employee in previous years will have no influence on his/her future salary at Firm A. Instead, the annual salary that Firm A will pay to each of its retained employees will be determined using a survey.

Firm A is asking all its employees (all students in the classroom) to specify the minimum annual salary that he/she would need to receive in order to remain with Firm A. Firm A will then pay the minimum salary necessary to voluntarily retain 50% of its employees. In particular, after collecting all "salary requests" from its employees, Firm A will lay off the 50% of employees who submitted the highest salary requests.

The employees laid off (50% of current Firm A employees) will immediately begin working at Firm B at the salary offered. The remaining employees will continue to work for Firm A.

All employees retained by Firm A will be paid the same salary, regardless of the salary they requested. These retained employees will be paid the lowest salary from the 50% of employees laid off.

Note that this salary will be higher than the salary requested by any of the retained employees.

Now, my partner will further explain the salary survey. (Appendix D includes the PowerPoint slides used for the experiment explanations.)

Now we will continue reading the instructions on the yellow sheet of paper.

YOUR SALARY REQUEST TO FIRM A

You must now decide what annual salary to request from Firm A.

Remember that if your request is among the highest 50% of the salary requests submitted, you will be laid off from Firm A and will immediately work for Firm B.

If your salary request to Firm A is not among the highest 50%, you will continue to work for Firm A and will receive an annual salary equal to the lowest salary requested from the 50% of employees not retained.

SALARY OFFERS FROM FIRM B

Under each of the post-it notes below, you will find a salary offer from Firm B. The number on each post-it note represents each round of bidding. You cannot share with other employees your offer from Firm B.

During the experimental rounds, you will write your salary request to Firm A on the green stack of papers located in front of you. Please look at these sheets now. These green sheets of paper have the round number and your ID number on top. Next to the word bid, you will submit your salary bid. Once you have written your bid, fold it in half and raise it above your head for an experimenter to collect. Once all bids are collected,

the results will be shown on the board in front of the class after every round. If there is a tie, Firm A will retain one additional employee.

Now turn your attention to the blue piece of paper titled "Salary Tracker." During the experiment you will use this sheet of paper to keep track of your salary received. For each corresponding round, you will write "yes" if you are retained and "no" if you are not retained by Firm A in the corresponding second column. If Firm A retains you, your salary will be displayed and circled on the board. You will record that salary in the column titled "Salary." If Firm A does not retain you, you will write the salary offered to you from Firm B in the column titled "Salary."

My partner will now provide an example. (Appendix D includes the PowerPoint slides for the experiment explanations.)

Now we will conduct the first round of experiments. Turn to your yellow papers and remove the post-it note labeled "1." This is your offer from Firm B, submit your salary bid to Firm A on the green piece of paper entitled Round 1. Once complete, fold and raise your paper above your head. (Continue for rounds 2 through 10). Once complete, pass out information for rounds 11 through 20.

B. CASH BID PLUS NON-MONETARY INCENTIVES

Now we will conduct the last ten rounds of the experiment. Do not touch any of the papers in front of you until instructed to do so. This portion of the experiment involves students making cash bids along with bids on non-monetary incentives. Non-monetary incentives, or NMIs, are rewards/benefits that are not money driven. Examples of NMIs could be, but are not limited to, sabbatical, telecommunicating, reserved parking, on-site childcare, on-site gym, quality cafeteria, etc.

You should have three stacks of papers in front of you, a yellow stack, a blue sheet, and a stack of pink sheets. Please turn your attention to the yellow sheets, which should say "Survey—Cash Bid Plus Non-monetary Incentives" at the top left side of the paper. Much of the information contained is similar to the previous 10 rounds of instructions. As I read, I will state which sections have not changed from the previous

instructions. Once again, your employee ID is located at the upper right hand side of the paper. This will be your identification code throughout the remainder of the experiment.

You can use the yellow papers as a reference if you need it at anytime during the rounds. The rounds will have all the same information and scenario. It is simply provided as a reference in case you would like to go back and review the scenario description.

I will now begin reading the description on your yellow paper. Do not remove any of the post-it notes until instructed to do so.

SCENARIO BACKGROUND

You are an employee of Firm A. The other students in the classroom are also employees of Firm A. There are no other employees in Firm A besides the students in the classroom.

Your only other potential employer is Firm B.

You have no particular preference between working for Firm A or for Firm B.

You can easily switch employers at no cost or inconvenience to you.

Your only goal is to maximize your total income (monetary and non-monetary benefits/income)

DOWNSIZING AT FIRM A

No change.

EMPLOYMENT OFFER FROM FIRM B

No change.

SALARY OFFER FROM FIRM B

No change.

DISTRIBUTION OF SALARY OFFERS FROM FIRM B

No change.

NON-MONETARY INCENTIVES AT FIRM A

Firm A now offers two non-monetary incentives that Firm B does not offer.

You do not know the cost of these non-monetary incentives; you only know how you value each non-monetary incentive.

SALARY SURVEY AT FIRM A

The salary paid to any Firm A employee in previous years will have no influence on his/her future salary at Firm A. Instead, the annual salary that Firm A will pay to each of its retained employees will be determined using a survey.

Firm A is asking all its employees (all students in the classroom) to specify the minimum annual salary that he/she would need to receive in order to remain with Firm A. Once you determine your minimum annual salary to be retained, Firm A is then asking how much you would give up from that salary for each non-monetary incentive. You will only receive a NMI if your bid for the NMI is greater than the cost to Firm A.

Firm A will then pay the minimum salary necessary to voluntarily retain 50% of its employees. In particular, after collecting all "salary requests" from its employees, Firm A will lay off the 50% of employees who submitted the highest salary requests.

The employees laid off (50% of current Firm A employees) will immediately begin working at Firm B at the salary offered. The remaining employees will continue to work for Firm A and receive those NMIs where their bid is greater than the non-monetary incentive cost to Firm A.

All employees retained by Firm A will be paid a base salary minus the cost of any non-monetary incentives they will receive. The base salary will be the lowest salary from the 50% of employees laid off.

Note that this salary will be higher than the salary requested by any of the retained employees.

Now, my partner will illustrate the bidding formula for NMIs. (Appendix D includes the PowerPoint slides for the experiment explanations.)

Now, I will continue reading the description on the yellow sheets of paper.

YOUR SALARY REQUEST TO FIRM A

You must now decide what annual salary to request from Firm A.

Your overall salary request to Firm A will be an initial salary, minus your bid for each NMI you receive where your bid is greater than cost to Firm A. Firm A will then calculate your cost to retain and use that as your competitive bid.

Remember that if your request is among the highest 50% of the salary requests submitted, you will be laid off from Firm A and will immediately work for Firm B.

If your salary request to Firm A is not among the highest 50%, you will continue to work for Firm A and will receive an annual base salary equal to the lowest salary requested from the 50% of employees not retained, plus any NMIs where your bid was greater than the cost. Actual cash salary will be the base salary minus the cost of any NMIs received.

SALARY OFFERS FROM FIRM B

Under each of the post-it notes below, you will find a salary offer from Firm B. The number on each post-it note represents each round of bidding. You cannot share with other employees your offer from Firm B.

NON-MONETARY INCENTIVES AT FIRM A

Also under each of the post-it notes below, you will find your value for each NMI. This figure represents your value for each individual NMI.

During the experimental rounds, you will write your salary request and bids for each non-monetary incentive to Firm A on the pink stack of papers located in front of you. Please look at these sheets now. These pink sheets of paper have the round number and your ID number on top. Next to the words initial bid, you will submit your initial salary bid. Below the words initial bid, next to the blank for each non-monetary incentive, you will submit your bid for the corresponding non-monetary incentive. Once you have written your bids, fold it in half and raise it above your head for an experimenter to collect. Once all bids are collected, the results will be shown on the board in front of the class after every round.

Now turn your attention to the blue piece of paper titled "Salary and NMI Tracker." During the experiment you will use this sheet of paper to keep track of your salary received. For each corresponding round, you will write "yes" if you are retained and "no" if you are not retained by Firm A in the corresponding second column. If Firm A retains you, your cash salary will be displayed and circled on the board. You will record that salary in the column titled "Cash Salary." Next, you will record any NMIs received in the column titled "NMI Received." If Firm A does not retain you, you will write the salary offered to you from Firm B in the column titled "Cash Salary" and write the word "None" under "NMI Received." If Firm A retains you, you will add your cash salary, which is the base salary minus the cost of any NMIs you received plus the value of each NMI received. The value of each NMI is given on the yellow sheet of paper for the corresponding round. This total is your "Value Received" and should be recorded in the corresponding column titled "Value Received." If employed by Firm B, simply write your salary offer from Firm B in the column "Value Received."

My partner will now provide an example. (Appendix D includes the PowerPoint slides for the experiment explanations.)

Now we will conduct the last ten rounds of the experiment. Turn to your yellow papers and remove the post-it note labeled "11." This is your offer from Firm B and your value for each of the two NMIs offered at Firm A. Submit your salary bid to Firm A on the pink piece of paper entitled Round 11. Once complete, fold and raise your paper above your head. (Continue for rounds 11 through 20).

C. CONCLUSION

Thank you for participating in this experiment for our MBA project. You will receive a brief during your next class period on the experiment and the hypothesis to your bidding strategies throughout the surveys.

Please complete the Experiment Exit Survey and leave them face down on your desk prior to your departure.

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APPENDIX D: EXPERIMENT POWERPOINT EXPLANATIONS

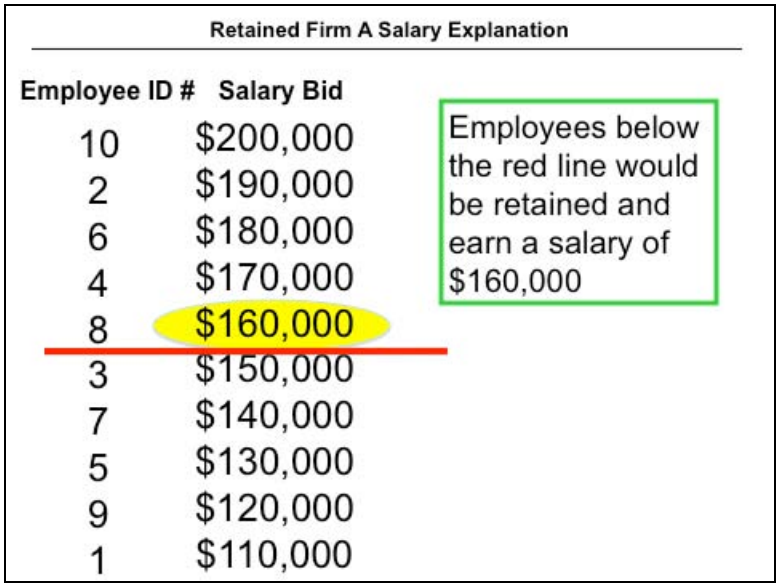

Figure 17. Cash Bid Only Retention Explanation

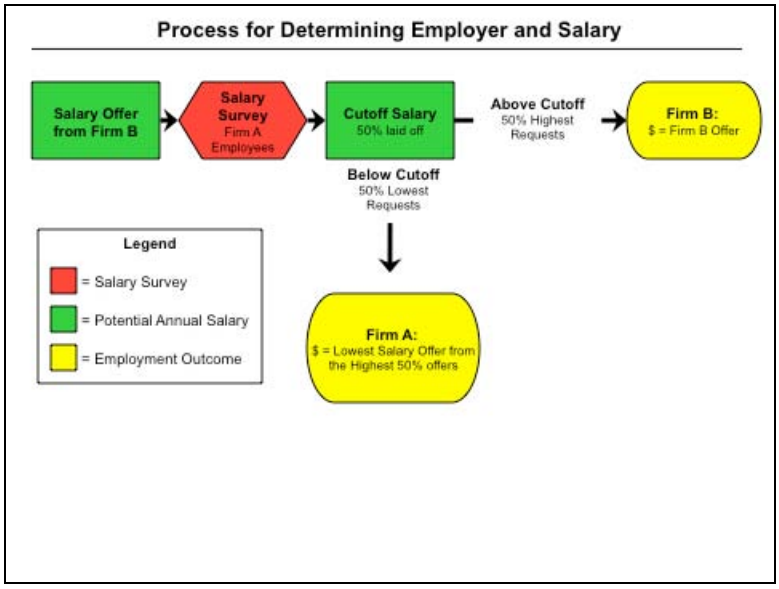

Figure 18. Cash Bid Only Experiment Flow Chart

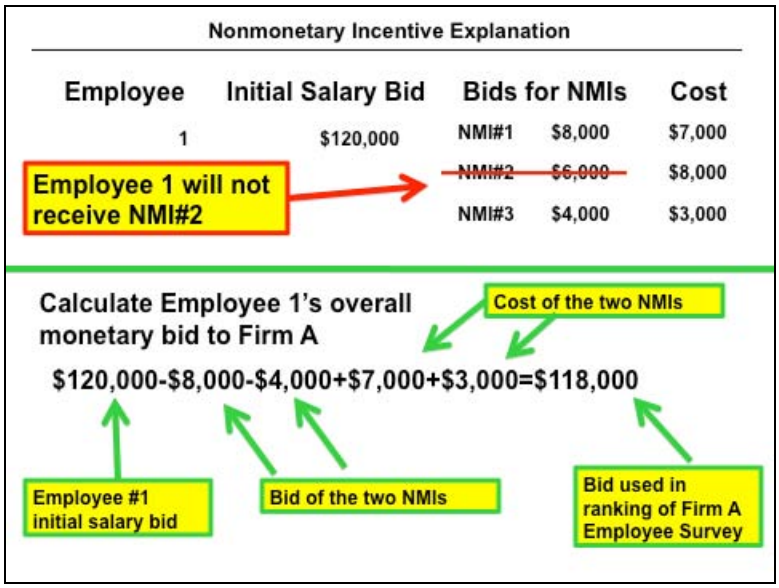

Figure 19. Cash Plus Non-monetary Incentives Explanation

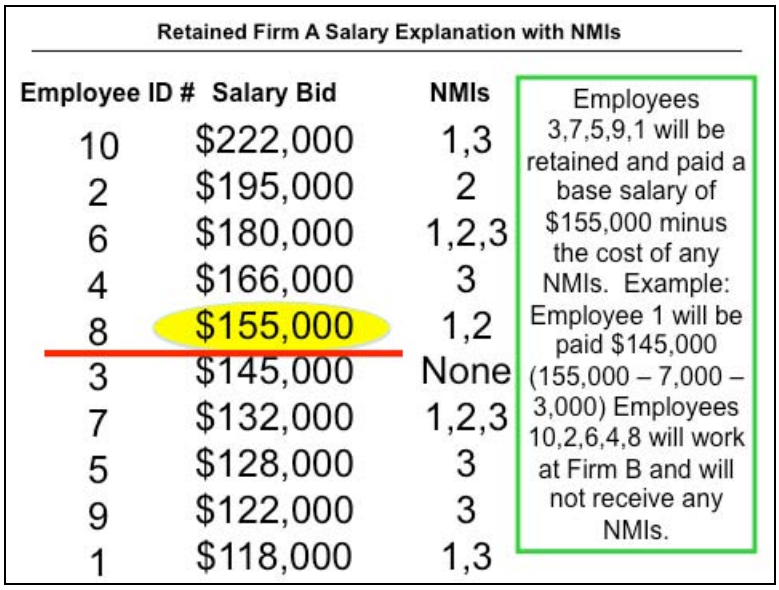

Figure 20. Cash Plus Non-monetary Incentive Retention Explanation

APPENDIX E: EXPERIMENTAL DATA GRAPHS

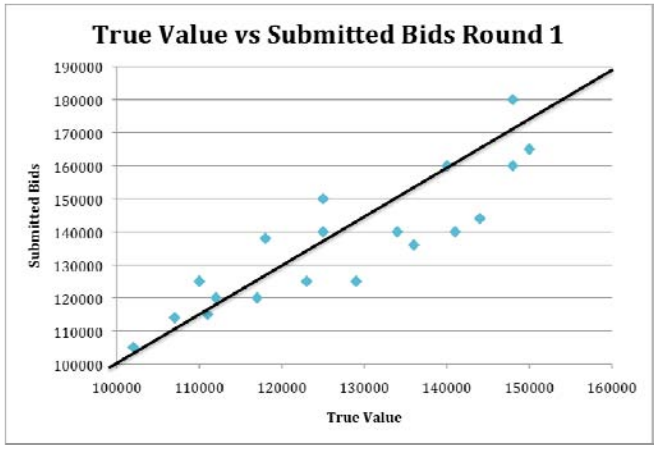

Figure 21. True Value vs. Submitted Bids Round 1, Experiment 1

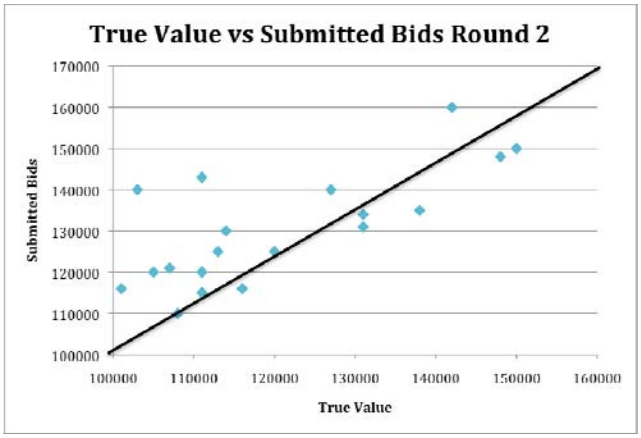

Figure 22. True Value vs. Submitted Bids Round 2, Experiment 1

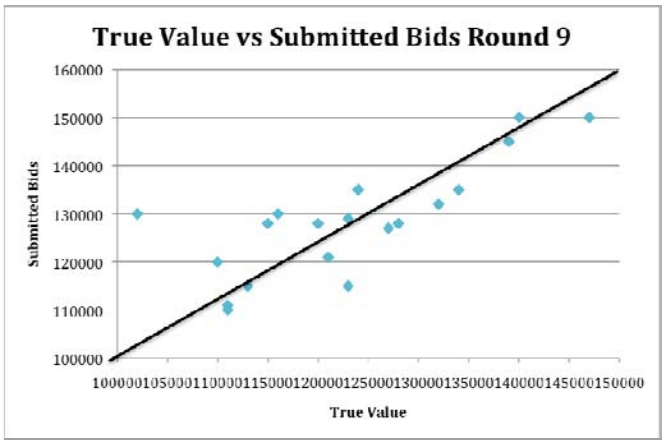

Figure 23. True Value vs. Submitted Bids Round 9, Experiment 1

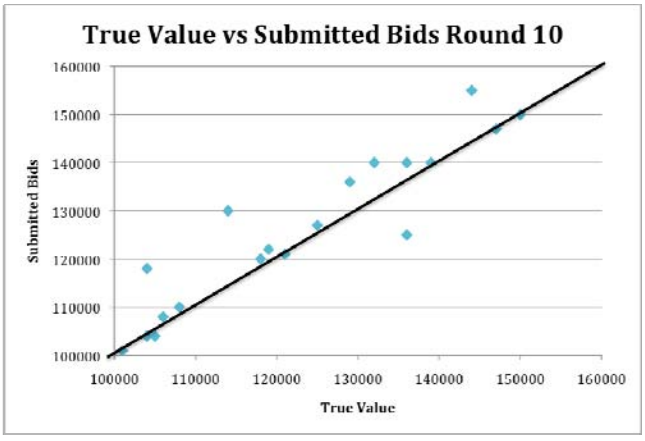

Figure 24. True Value vs. Submitted Bids Round 10, Experiment 1

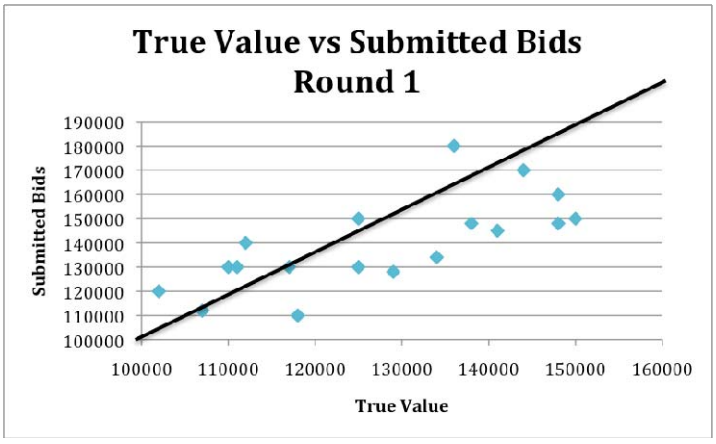

Figure 25. True Value vs. Submitted Bids Round 1, Experiment 2

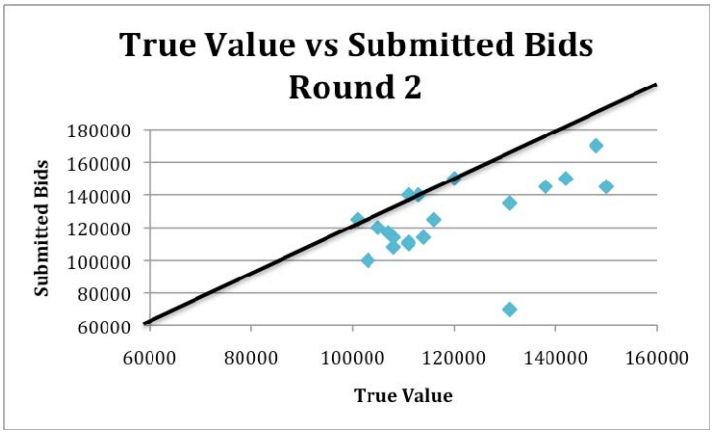

Figure 26. True Value vs. Submitted Bids Round 2, Experiment 2

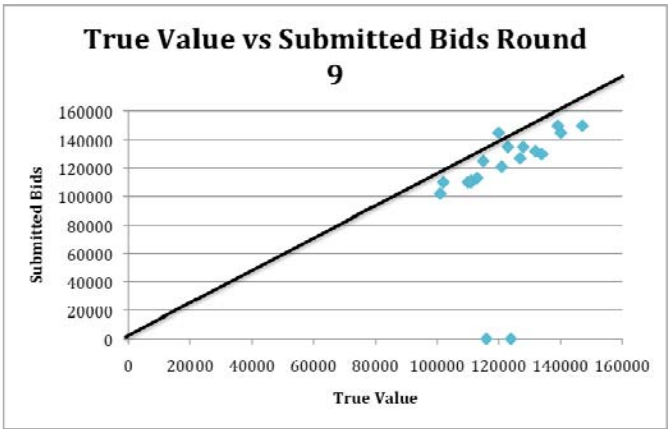

Figure 27. True Value vs. Submitted Bids Round 9, Experiment 2

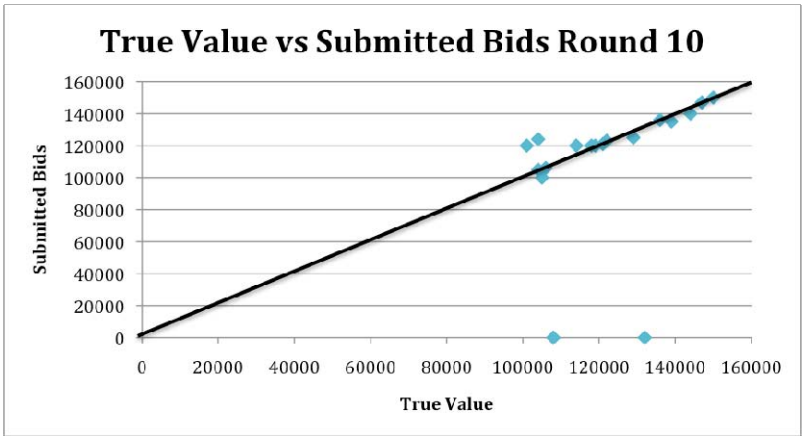

Figure 28. True Value vs. Submitted Bids Round 10, Experiment 2

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LIST OF REFERENCES

Chief of Naval Operations, *Junior Surface Warfare Critical Skills Retention Bonus*, Navy Message (Washington, D C: CNO Washington, DC, 2006).

Coughlan, Peter J. and William R. Gates, "Monetary and Non-Monetary SWO Retention Bonuses: The Combinatorial Retention Auction Mechanism (CRAM)" (lecture, Naval Postgraduate School, Monterey, CA, May 6, 2007).

Coughlan, Peter J., William R. Gates, and Brooke M. Zimmerman, "The Combinatorial Retention Auction Mechanism (CRAM): Integrating Monetary and Non-Monetary Re-Enlistment Incentives." (Technical report, Naval Postgraduate Scool, forthcoming)

Coursey, Don, *Vernon Smith, Economic Experiments, and the Visible Hand*, OCT 28, 2002, http://www.econlib.org/library/Columns/CourseyVSmith.html (accessed October15, 2009).

Davis, Douglas D. and Charles A. Holt, *Experimental Economics* (New Jersey: Princenton University Press, 1993).

Defense Finance and Accounting Service, *DFAS - Military Pay Tables*, January 1, 2009, http://www.dfas.mil/militarypay/militarypaytables.html (accessed March 18, 2009).

Denmond, Constance M., Derek N. Johnson, Chavius G. Lewis, and Christopher R. Zegley, "Combinatorial Auction Theory Applied to the Selection of Surface Warfare Incentives" (MBA professional report, Naval Postgraduate School, 2007).

Ellis, Jason B., "Variability of Valuation of Non-Monetary Incentives: Motivating and Implementing the Combinatorial Retention Auction Mechanism" (master's thesis, Naval Postgraduate School, 2009).

Experimentation Definitions, http://www.stat.yale.edu/Courses/1997-98/101/expdes.htm (accessed Otober 15, 2009).

Get Into Academy, *Updated Value of Education for USNA, USMA, and USAFA*, January 1, 2007, http://www.getintoacademy.com/57/updated-2007-2008-value-of-education-for-usma-usna-and-usafa/ (accessed March 18, 2009).

Graham, Sharron, "An Exploratory Study: Female Surface Warfare Officers' Decisions to Leave Their Community" (master's thesis, Naval Postgraduate School, 2006).

Hall, Robert E. and Marc Lieberman, *Economics: Principles and Applications*, 4 (Mason, OH: Thomson Higher Education, 2008).

Merriam-Webster Online Dictionary, http://www.merriam-webster.com/dictionary/decision%20theory (accessed October 15, 2009).

Naval History and Heritage Command, *The Birth of the United States Navy*, October 4, 2000, http://www.history.Navy.mil/faqs/faq31-1.htm (accessed March 18, 2009).

Navy Personnel Command PERS41, *SWO Career Planning Brief*, http://www.npc.Navy.mil/NR/rdonlyres/71C709C7-0D35-4329-9257-CEF93B366A38/0/SWOCareerPlanningBrief0903.pdf (lecture, Naval Postgraduate School, Monterey, CA, March 18, 2009).

Norton, William J., "Using an Experimental Approach to Improving the Selective Reenlistment Bonus Program" (master's thesis, Naval Postgraduate School, 2007).

Princeton, *Word Net Search*, http://wordnetweb.princeton.edu/perl/webwn?s=economics (accessed October 15, 2009).

Secretary of the Navy, *SECNAVINST 7220.84 Surface Warfare Officer Continuation Pay*, Instruction (Washington, DC: SECNAV, 2000).

U.S. Congressional Record–House, *H4165 Congressional Record House 14 June 1999*, Report (Washington, DC: Congress, 1999).

Zimmerman, Brook M., "Integrating Monetary and Non-Monetary Reenlistment Incentives Utilizing the Combinatorial Retention Auction Mechanism (CRAM)" (master's thesis, Naval Postgraduate School, 2008).

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